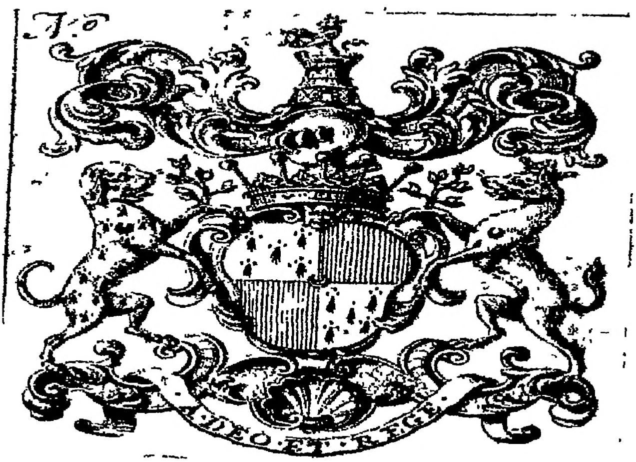
A·DEO·ET·REGE·

PHILOSOPHICAL TRANSACTIONS,

GIVING SOME

ACCOUNT

OF THE

Present Undertakings, Studies, *and* Labours,

OF THE

INGENIOUS,

IN MANY

Considerable Parts of the WORLD.

VOL. LXI. For the Year 1771.

PART I.

LONDON:

Printed for LOCKYER DAVIS, in *Holbourn*,
Printer to the ROYAL SOCIETY.

M.DCC.LXXII.

ADVERTISEMENT.

THE Committee appointed by the *Royal Society* to direct the publication of the *Philosophical Transactions*, take this opportunity to acquaint the Public, that it fully appears, as well from the council-books and journals of the Society, as from repeated declarations, which have been made in several former *Transactions*, that the printing of them was always, from time to time, the single act of the respective Secretaries, till the Forty-seventh Volume. And this information was thought the more necessary, not only as it has been the common opinion, that they were published by the authority, and under the direction, of the Society itself; but also, because several authors, both at home and abroad, have in their writings called them the *Transactions of the Royal Society*. Whereas in truth the Society, as a body, never did interest themselves any further in their publication, than by occasionally recommending the revival of them to some of their Secretaries, when, from the particular circumstances of their affairs, the *Transactions* had happened for any length of time to be intermitted. And this seems principally to have been done with a view to satisfy the Public, that their usual meetings were then continued for the improvement of knowledge, and benefit of mankind, the great ends of their first institution by the Royal Charters, and which they have ever since steadily pursued.

But the Society being of late years greatly inlarged, and their communications more numerous, it was thought adviseable, that a Committee of their Members should be appointed to reconsider the papers read before them, and select out of them such, as they

should

ſhould judge moſt proper for publication in the future *Tranſactions*; which was accordingly done upon the 26th of March 1752. And the grounds of their choice are, and will continue to be, the importance or ſingularity of the ſubjects, or the advantageous manner of treating them; without pretending to anſwer for the certainty of the facts, or propriety of the reaſonings, contained in the ſeveral papers ſo publiſhed, which muſt ſtill reſt on the credit or judgment of their reſpective authors.

It is likewiſe neceſſary on this occaſion to remark, that it is an eſtabliſhed rule of the Society, to which they will always adhere, never to give their opinion, as a body, upon any ſubject, either of Nature or Art, that comes before them. And therefore the thanks, which are frequently propoſed from the chair, to be given to the authors of ſuch papers, as are read at their accuſtomed meetings, or to the perſons through whoſe hands they receive them, are to be conſidered in no other light than as a matter of civility, in return for the reſpect ſhewn to the Society by thoſe communications. The like alſo is to be ſaid with regard to the ſeveral projects, inventions, and curioſities of various kinds, which are often exhibited to the Society; the authors whereof, or thoſe who exhibit them, frequently take the liberty to report, and even to certify in the public news-papers, that they have met with the higheſt applauſe and approbation. And therefore it is hoped, that no regard will hereafter be paid to ſuch reports, and public notices; which in ſome inſtances have been too lightly credited, to the diſhonour of the Society.

CON-

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PRESENTS

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WITH

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PHILO-

PHILOSOPHICAL TRANSACTIONS.

I. *Remarks upon the Nature of the Soil of* Naples, *and it's Neighbourhood; in a Letter from the Honourable* William Hamilton, *His Majesty's Envoy Extraordinary at* Naples, *to* Mathew Maty, *M. D. Sec. R. S.*

SIR,

Naples, Oct. 16, 1770.

Read Jan. 10. 17. 24. 1771.

ACCORDING to your desire, I lose no time in sending you such further remarks as I have been making with some diligence, for six years past, in the compass of twenty miles or more, round this capital. By accompanying these remarks with a map of the country I describe, and with the specimens of different matters that compose the most remarkable spots of it, I do

I do not doubt but that I ſhall convince you, as I am myſelf convinced, that the whole circuit (ſo far as I have examined) within the boundaries marked in the map, is wholly and totally the production of ſubterraneous fires; and that moſt probably the ſea formerly reached the mountains that lie behind Capua and Caſerta, and are a continuation of the Appennines. If I may be allowed to compare ſmall things with great, I imagine the ſubterraneous fires to have worked in this country under the bottom of the ſea, as moles in a field, throwing up here and there a hillock, and that the matter thrown out of ſome of theſe hillocks formed into ſettled volcanos, filling up the ſpace between one and the other, has compoſed this part of the continent, and many of the iſlands adjoining.

From the obſervations I have made upon mount Etna, Veſuvius, and its neighbourhood, I dare ſay, that, after a careful examination, moſt mountains that are, or have been volcanos, would be found to owe their exiſtence to ſubterraneous fire; the direct reverſe of what I find the commonly received opinion.

Nature, though varied, is certainly in general uniform in her operations; and I cannot conceive that two ſuch conſiderable volcanos as Etna and Veſuvius ſhould have been formed otherwiſe, than every other conſiderable volcano of the known world. I do not wonder that ſo little progreſs has been made in the improvement of natural hiſtory, and particularly in that branch of it which regards the theory of the earth; nature acts ſlowly, it is difficult to catch her in the fact. Thoſe who have made this

ſubject

ſubject their ſtudy have, without ſcruple, undertaken at once, to write the natural hiſtory of a whole province, or of an entire continent; not reflecting, that the longeſt life of man ſcarcely affords him time to give a perfect one of the ſmalleſt inſect.

I am ſenſible of what I undertake in giving you, Sir, even a very imperfect account of the nature of the ſoil of a little more than twenty miles round Naples: yet I flatter myſelf that my remarks, ſuch as they are, may be of ſome uſe to any one hereafter, who may have leiſure and inclination to follow them up. The kingdom of the Two Sicilies offers certainly the faireſt field for obſervations of this kind, of any in the whole world; here are volcanos exiſting in their full force, ſome on their decline, and others totally extinct.

To begin with ſome degree of order, which is really difficult in the variety of matter that occurs to my mind, I will firſt mention the baſis on which I found all my conjectures. It is the nature of the ſoil that covers the antient towns of Herculaneum and Pompeii, and the interior and exterior form of the new mountain, near Puzzole, with the ſort of materials of which it is compoſed. It cannot be denied that Herculaneum and Pompeii ſtood once above ground; though now, the former is in no part leſs than ſeventy feet, and in ſome parts one hundred and twelve feet, below the preſent ſurface of the earth; and the latter is buried ten or twelve feet deep, more or leſs. As we know from the very accurate account given by Pliny the younger, to Tacitus, and from the accounts of other contemporary authors, that theſe towns were buried by an eruption

of mount Vesuvius in the time of Titus; it must be allowed, that whatever matter lies between these cities and the present surface of the earth over them, must have been produced since the year 79 of the Christian æra, the date of that formidable eruption.

Pompeii, which is situated at a much greater distance from the volcano than Herculaneum, has felt the effects of a single eruption only; it is covered with white pumice stones mixed with fragments of lava and burnt matter, large and small; the pumice is very light, but I have found some of the fragments of lava and cinders there, weighing eight pounds. I have often wondered that such weighty bodies could have been carried to such a distance (for Pompeii cannot be less than five miles, in a strait line, from the mouth of Vesuvius). Every observation confirms the fall of this horrid shower over the unfortunate city of Pompeii, and that few of its inhabitants had dared to venture out of their houses; for in many of those which have been already cleared, skeletons have been found, some with gold rings, ear rings, and bracelets. I have been present at the discovery of several human skeletons myself; and under a vaulted arch, about two years ago, at Pompeii, I saw the bones of a man and a horse taken up, with the fragments of the horse's furniture, which had been ornamented with false gems set in bronze. The skulls of some of the skeletons found in the streets had been evidently fractured by the fall of the stones. His Sicilian majesty's excavations are confined to this spot at present; and the curious in antiquity may expect hereafter, from so rich a mine, ample matter for their dissertations: but I will confine myself

to

to such observations only as relate to my present subject.

Over the stratum of pumice and burnt matter that covers Pompeii, there is a stratum of good mould, of the thickness of about two feet and more in some parts, in which vines flourish, except in some particular spots of this vineyard, where they are subject to be blasted by a foul vapour or *mofete*, as it is called here, that rises from beneath the burnt matter. The abovementioned shower of pumice stones, according to my observations, extended beyond Castel-a-mare (near which spot the ancient town of Stabia also lies buried under them), and covered a tract of country not less than thirty miles in circumference. It was at Stabia that Pliny the elder lost his life, and this shower of pumice stones is well described in the younger Pliny's letter. Little of the matter that has issued from Vesuvius since that time, has reached these parts: but I must observe that the pavement of the streets of Pompeii is of lava; nay, under the foundation of the town, there is a deep stratum of lava and burnt matter. These circumstances, with many others that will be related hereafter, prove, beyond a doubt, that there have been eruptions of Vesuvius previous to that of the year 79, which is the first recorded by history.

The growth of soil by time is easily accounted for; and who, that has visited ruins of ancient edifices, has not often seen a flourishing shrub, in a good soil, upon the top of an old wall? I have remarked many such on the most considerable ruins at Rome and elsewhere. But from the soil which has grown over the barren pumice that covers Pompeii, I was

enabled

enabled to make a curious obſervation. Upon examining the cuts and hollow ways made by currents of water in the neighbourhood of Veſuvius and of other volcanos, I had remarked that there lay frequently a ſtratum of rich ſoil, of more or leſs depth, between the matter produced by the exploſion of ſucceeding eruptions; and I was naturally led to think that ſuch a ſtratum had grown in the ſame manner as the one abovementioned over the pumice of Pompeii. Where the ſtratum of good ſoil was thick, it was evident to me that many years had elapſed between one eruption and that which ſucceeded it. I do not pretend to ſay that a juſt eſtimate can be formed of the great age of volcanos from this obſervation, but ſome ſort of calculation might be made; for inſtance, ſhould an exploſion of pumice cover again the ſpot under which Pompeii is buried, the ſtratum of rich ſoil abovementioned would certainly lie between two beds of pumice; and if a like accident had happened a thouſand years ago, the ſtratum of rich ſoil would as certainly have wanted much of its preſent thickneſs, as the rotting of vegetables, manure, &c. is ever increaſing a cultivated ſoil. Whenever I find then a ſucceſſion of different ſtrata of pumice and burnt matter like that which covers Pompeii, intermixed with ſtrata of rich ſoil, of greater or leſs depth, I hope I may be allowed reaſonably to conclude, that the whole has been the production of a long ſeries of eruptions occaſioned by ſubterraneous fire. By the ſize and weight of the pumice, and fragments of burnt erupted matter in theſe ſtrata, it is eaſy to trace them up to their ſource, which I have done more than once in the neighbour-

hood

hood of Puzzole, where explosions have been frequent. The gradual decrease in the size and quantity of the erupted matter in the stratum abovementioned, from Pompeii to Castle-a-Mare, is very visible: at Pompeii, as I said before, I have found them of eight pounds weight, when at Castle-a-Mare the largest do not weigh an ounce.

The matter which covers the ancient town of Herculaneum is not the produce of one eruption only; for there are evident marks that the matter of six eruptions has taken its course over that which lies immediately above the town, and was the cause of its destruction. These strata are either of lava or burnt matter, with veins of good soil between them. The stratum of erupted matter that immediately covers the town, and with which the theatre and most of the houses were filled, is not of that foul vitrified matter, called lava, but of a sort of soft stone, composed of pumice, ashes, and burnt matter. It is exactly of the same nature with what is called here the Naples stone; the Italians distinguish it by the name of *tufa*, and it is in general use for building. Its colour is usually that of our free stone, but sometimes tinged with grey, green, and yellow; and the pumice stones, with which it ever abounds, are sometimes large and sometimes small: it varies likewise in its degree of solidity.

The chief article in the composition of this *tufa* seems to me to be, that fine burnt material, which is called *puzzolane*, whose binding quality and utility by way of cement are mentioned by Vitruvius, and which is to be met with only in countries that have been subject to subterraneous fires. It is, I believe, a sort of lime prepared

pared by nature. This, mixed with water, great or ſmall pumice ſtones, fragments of lava, and burnt matter, may naturally be ſuppoſed to harden into a ſtone of this kind; and, as water frequently attends eruptions of fire, as will be ſeen in the accounts I ſhall give of the formation of the new mountain near Puzzole, I am convinced the firſt matter that iſſued from Veſuvius, and covered Herculaneum, was in the ſtate of liquid mud. A circumſtance ſtrongly favouring my opinion is, that, about two years ago, I ſaw the head of an antique ſtatue dug out of this matter within the theatre of Herculaneum; the impreſſion of its face remains to this day in the *tufa*, and might ſerve as a mould for a caſt in plaiſter of Paris, being as perfect as any mould I ever ſaw. As much may be inferred from the exact reſemblance of this matter, or *tufa*, which immediately covers Herculaneum, to all the *tufa's* of which the high grounds of Naples and its neighbourhood are compoſed; I detached a piece of it ſticking to, and incorporated with, the painted ſtucco of the inſide of the theatre of Herculaneum, and ſhall ſend it for your inſpection *. It is very different, as you will ſee, from the vitrified matter called lava, by which it has been generally thought that Herculaneum was deſtroyed. The village of Reſina and ſome villas ſtand at preſent above this unfortunate town.

To account for the very great difference of the matters that cover Herculaneum and Pompeii, I have often thought that in the eruption of 79 the moun-

* This piece is now in the Muſeum of the Royal Society, together with many other ſpecimens, mentioned in this and in the following letter. M. M.

tain muſt have been open in more than one place. A paſſage in Pliny's letter to Tacitus ſeems to ſay as much, "*Interim e Veſuvio monte pluribus locis latiſſimæ* "*flammæ, atque incendia relucebant, quorum fulgor et* "*claritas tenebras noctis pellebat*:" ſo that very probably the matter that covers Pompeii proceeded from a mouth, or crater, much nearer to it than is the great mouth of the volcano, from whence came the matter that covers Herculaneum. This matter might nevertheleſs be ſaid to have proceeded from Veſuvius, juſt as the eruption in the year 1760, which was quite independent of the great crater (being four miles from it), is properly called an eruption of Veſuvius.

In the beginning of eruptions, volcanos frequently throw up water mixed with the aſhes. Veſuvius did ſo in the eruption of 1631, according to the teſtimony of many contemporary writers. The ſame circumſtance happened in 1669 according to the account of Ignazzio Sorrentino, who, by his Hiſtory of Mount Veſuvius printed at Naples in 1734, has ſhewn himſelf to have been a very accurate obſerver of the phænomena of the volcano, for many years that he lived at Torre del Greco, ſituated at the foot of it. At the beginning of the formation of the new mountain, near Puzzole, water was mixed with the aſhes thrown up, as will be ſeen in two very curious and particular accounts of the formation of that mountain, which I ſhall have the pleaſure of communicating to you preſently; and in 1755 Etna threw up a quantity of water in the beginning of an eruption, as is mentioned in the letter I ſent you laſt

year upon the subject of that magnificent volcano *. Ulloa likewise mentions this circumstance of water attending the eruptions of volcanos in America. Whenever therefore I find a *tufa* composed exactly like that which immediately covers Herculaneum, and undoubtedly proceeded from Vesuvius, I conclude such a *tufa* to have been produced by water mixing with the erupted matter at the time of an explosion occasioned by subterraneous fire; and this observation, I believe, will be of more use than any other, in pointing out those parts of the present *terra firma*, that have been formed by explosion. I am convinced it has often happened that subterraneous fires and exhalations, after having been pent up and confined for some time, and been the cause of earthquakes, have forced their passage, and in venting themselves formed mountains of the matter that confined them, as you will see was the case near Puzzole in the year 1538, and by evident signs has been so before, in many parts of the neighbourhood of Puzzole; without creating a regular volcano. The materials of such mountains will have but little appearance of having been produced by fire, to any one unaccustomed to make observations upon the different nature of volcanos.

If it were allowed to make a comparison between the earth and a human body, one might consider a country replete with combustibles occasioning explosions (which is surely the case here) to be like a body full of humours. When these humours concentre in one part, and form a great tumour out of which they are discharged freely, the body is less

* Phil. Transact. Vol. LX. p. 1.

agitated;

agitated; but when by any accident the humours are checked, and do not find a free paſſage through their uſual channel, the body is agitated, and tumours appear in other parts of that body, but ſoon after the humours return again to their former channel. In a ſimilar manner one may conceive Veſuvius to be the preſent great channel, through which nature diſcharges ſome of the foul humours of the earth; when theſe humours are checked by any accident or ſtoppage in this channel for any conſiderable time, earthquakes will be frequent in its neighbourhood, and exploſions may be apprehended even at ſome diſtance from it. This was the caſe in the year 1538, Veſuvius having been quiet for near 400 years. There was no eruption from its great crater from the year 1139 to the great eruption of 1631, and the top of the mountain began to loſe all ſigns of fire. As it is not foreign to my purpoſe, and will ſerve to ſhew how greatly they are miſtaken, who place the ſeat of the fire in the centre or towards the top of a volcano, I will give you a curious deſcription of the ſtate of the crater of Veſuvius, after having been free from eruptions 492 years, as related by Bracini, who deſcended into it not long before the eruption of 1631: "The crater was five miles in "circumference, and about a thouſand paces deep; its "ſides were covered with bruſh wood, and at the "bottom there was a plain on which cattle grazed. "In the woody parts, boars frequently harboured; "in the midſt of the plain, within the crater, was a "narrow paſſage, through which, by a winding path, "you could deſcend about a mile amongſt rocks and "ſtones, till you came to another more ſpacious

 "plain

" plain covered with aſhes: in this plain were three " little pools, placed in a triangular form, one to- " wards the Eaſt, of hot water, corroſive and bitter " beyond meaſure; another towards the Weſt, of " water ſalter than that of the ſea; the third of hot " water, that had no particular taſte."

The great increaſe of the cone of Veſuvius, from that time to this, naturally induces one to conclude, that the whole of the cone was raiſed in the like manner, and that the part of Veſuvius, called Somma, which is now conſidered as a diſtinct mountain from it, was compoſed in the ſame manner. This may plainly be perceived by examining its interior and exterior form, and the ſtrata of lava and burnt matter of which it is compoſed. The ancients, in deſcribing Veſuvius, never mention two mountains. Strabo, Dio, Vitruvius, all agree, that Veſuvius, in their time, ſhewed ſigns of having formerly erupted, and the firſt compares the crater on its top to an amphitheatre. The mountain now called Somma was, I believe, that which the ancients called Veſuvius; its outſide form is conical, its inſide, inſtead of an amphitheatre, is now like a great theatre. I ſuppoſe the eruption in Pliny's time to have thrown down that part of the cone next the ſea, which would naturally have left it in its preſent ſtate, and that the conical mountain, now exiſting Veſuvius, has been raiſed by the ſucceeding eruptions: all my obſervations confirm this opinion. I have ſeen antient lavas in the plain on the other ſide of Somma, which could never have proceeded from the preſent Veſuvius. Serao, a celebrated phyſician now living at Naples, in the introduction of his account of the eruption of Veſu-

vius in 1737 (in which account many of the phænomena of the volcano are recorded and very well accounted for) ſays, that at the convent of Dominican Fryars, called the Madona del Arco, ſome years ago, in ſinking a well, at a hundred feet depth, a lava was diſcovered, and ſoon after another, ſo that in leſs than three hundred feet depth, the lavas of four eruptions were found. From the ſituation of this convent it is clear beyond a doubt, that theſe lavas proceeded from the mountain called Somma, as they are quite out of the reach of the exiſting volcano.

From theſe circumſtances, and from repeated obſervations I have made in the neighbourhood of Veſuvius, I am ſure that no virgin ſoil is to be found there, and that all is compoſed of different ſtrata of erupted matter, even to a great depth below the level of the ſea. In ſhort, I have not any doubt in my own mind, but that this volcano took its riſe from the bottom of the ſea; and as the whole plain between Veſuvius and the mountains behind Caſerta, which is the beſt part of the Campagna Felice, is (under its good ſoil) compoſed of burnt matter, I imagine the ſea to have waſhed the feet of thoſe mountains, until the ſubterraneous fires began to operate, at a period certainly of a moſt remote antiquity.

The ſoil of the Campagna Felice is very fertile; I ſaw the earth opened in many places laſt year in the midſt of that plain, when they were ſeeking for materials to mend the road from Naples to Caſerta. The ſtratum of good ſoil was in general four or five feet thick; under which was a deep ſtratum of cinders, pumice, fragments of lava and ſuch burnt matter as abounds near Veſuvius and all volcanos.

The

The mountains at the back of Caſerta are moſtly of a ſort of lime-ſtone, and very different from thoſe formed by fire; though Signior Van Vitelli, the celebrated architect, has aſſured me, that in the cutting of the famous aqueduct of Caſerta through theſe mountains, he met with ſome ſoils, that had been evidently formed by ſubterraneous fires. The high grounds which extend from Caſtel-a-Mare to the point of Minerva towards the iſland of Caprea, and from the promontory that divides the bay of Naples from that of Salerno, are of lime ſtone. The plain of Sorrento, that is bounded by theſe high grounds, beginning at the village of Vico, and ending at that of Maſſa, is wholly compoſed of the ſame ſort of *tufa* as that about Naples, except that the cinder or pumice ſtones intermixed in it are larger than in the Naples *tufa*. I conceive then that there has been an exploſion in this ſpot from the bottom of the ſea. This plain, as I have remarked to be the caſe with all ſoils produced by ſubterraneous fire, is extremely fertile; whilſt the ground about it, being of another nature, is not ſo. The iſland of Caprea does not ſhew any ſigns of having been formed by ſubterraneous fire, but is of the ſame nature as the high grounds laſt mentioned, from which it has been probably detached by earthquakes, or the violence of the waves. Rovigliano, an iſland, or rather a rock in the bay of Caſtel-a-Mare, is likewiſe of lime ſtone, and ſeems to have belonged to the original mountains in its neighbourhood; in ſome of theſe mountains there are alſo petrified fiſh and foſſil ſhells, which I never have found in the mountains, which I ſuppoſe to have been formed by exploſion.

You

You have now, Sir, before you the nature of the soil, from Caprea to Naples. The soil on which this great metropolis stands has been evidently produced by explosions, some of which seem to have been upon the very spot on which this city is built; all the high grounds round Naples, Pausilipo, Puzzole, Baïa, Misenum, the islands of Procita and Ischia, all appear to have been raised by explosion. You can trace still in many of these heights the conical shape that was naturally given them at first, and even the craters out of which the matter issued, though to be sure others of these heights have suffered such changes by the hand of time, that you can only conjecture that they were raised in the like manner, by their composition being exactly the same as that of those mountains, which still retain their conical form and craters entire. A *tufa*, exactly resembling the specimen I took from the inside of the theatre of Herculaneum, layers of pumice intermixed with layers of good soil, just like those over Pompeii, and lavas like those of Vesuvius, compose the whole soil of the country that remains to be described.

The famous grotto anciently cut through the mountain of Pausilipo, to make a road from Naples to Puzzole, gives you an opportunity of seeing that the whole of that mountain is *tufa*. The first evident crater you meet with, after you have passed the grotto of Pausilipo, is now the lake of Agnano; a small remain of the subterraneous fire (which must probably have made the bason for the lake, and raised the high grounds which form a sort of amphitheatre round it) serves to heat rooms, which the Neapolitans make great use of in summer, for carrying off

diverse

diverſe diſorders, by a ſtrong perſpiration. This place is called the Sudatorio di San Germano; near the preſent bagnios, which are but poor little hovels, there are the ruins of a magnificent ancient bath. About an hundred paces from hence is the Grotto del Cane; I ſhall only mention, as a further proof of the probability that the lake of Agnano was a volcano, that vapours of a pernicious quality, as that in the Grotto del Cane, are frequently met with in the neighbourhood of Etna and Veſuvius, particularly at the time of, before, and after, great eruptions. The noxious vapour having continued in the ſame force conſtantly ſo many ages, as it has done in the Grotto del Cane (for Pliny mentions this Grotto), is indeed a circumſtance in which it differs from the vapours near Veſuvius and Etna, which are not conſtant; the cone forming the outſide of this ſuppoſed volcano is ſtill perfect in many parts.

Oppoſite to the Grotto del Cane, and immediately joining to the lake, riſes the mountain called Aſtruni, which, having, as I imagine, been thrown up by an exploſion of a much later date, retains the conical ſhape and every ſymptom of a volcano in much greater perfection than that I have been deſcribing. The crater of Aſtruni is ſurrounded with a wall to confine boars and deer (this volcano having been for many years converted to a royal chace). It may be about ſix miles or more in circumference; in the plain at the bottom of the crater are two lakes, and in ſome books there is mention made of a hot ſpring, which I never have been able to find. There are many huge rocks of lava within the crater of Aſtruni; and ſome I have met with alſo in that of Agnano;

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the cones of both theſe ſuppoſed volcanos are compoſed of *tufa* and ſtrata of looſe pumice, fragments of lava and other burnt matter, exactly reſembling the ſtrata of Veſuvius. Bartholomeus Fatius, who wrote of the actions of king Alphonſo the firſt (before the new mountain had been formed near Puzzole), conjectured that Aſtruni had been a volcano. Theſe are his words: *Locus Neapoli quatuor millia paſſuum proximus, quem vulgo Liſtrones vocant, nos unum e Phlegreeis Campis ab ardore nuncupandum putamus.* There is no entrance into the crater of either Aſtruni or Agnano, except one, evidently made by art, and they both exactly correſpond with Strabo's deſcription of avenues; the ſame may be ſaid of the Solfaterra and the Monte Gauro, or Barbaro as it is ſometimes called, which I ſhall deſcribe preſently.

Near Aſtruni and towards the ſea riſes the Solfaterra, which not only retains its cone and crater, but much of its former heat. In the plain within the crater, ſmoke iſſues from many parts, as alſo from its ſides; here, by means of ſtones and tiles heaped over the crevices, through which the ſmoak paſſes, they collect in an aukward manner what they call *ſale armoniaco*; and from the ſand of the plain they extract ſulphur and alum. This ſpot well attended to might certainly produce a good revenue, whereas I doubt if they have hitherto ever cleared 200 *l.* a year by it. The hollow ſound produced by throwing a heavy ſtone on the plain of the crater of the Solfaterra ſeems to indicate, that it is ſupported by a ſort of arched natural vault; and one is induced to think that there is a pool of water beneath this vault (which boils by the heat of a ſubterraneous fire ſtill deeper)

 by

by the very moiſt ſtream that iſſues from the cracks in the plain of the Solfaterra, which, like that of boiling water, runs off a ſword or knife, preſented to it, in great drops. On the outſide, and at the foot of the cone of the Solfaterra, towards the lake of Agnano, water ruſhes out of the rocks, ſo hot, as to raiſe the quickſilver in Fahrenheit's thermometer to the degree of boiling water a fact of which I was myſelf an eye-witneſs. This place, well worthy the obſervation of the curious, has been taken little notice of; it is called the *Piſciarelli*. The common people of Naples have great faith in the efficacy of this water, and make much uſe of it in all cutaneous diſorders, as well as for another diſorder that prevails here. It ſeems to be impregnated chiefly with ſulphur and alum. When you approach your ear to the rocks of the Piſciarelli, from whence this water ouzes, you hear a horrid boiling noiſe, which ſeems to proceed from the huge cauldron, that may be ſuppoſed to be under the plain of the Solfaterra. On the other ſide of the Solfaterra, next the ſea, there is a rock which has communicated with the ſea, till part of it was cut away to make the road to Puzzole; this was undoubtedly a conſiderable lava that ran from the Solfaterra when it was an active volcano. Under this rock of lava, which is more than ſeventy feet high, there is a ſtratum of pumice and aſhes. This ancient lava is about a quarter of a mile broad; you meet with it abruptly before you come in ſight of Puzzole, and it finiſhes as abruptly within about an hundred paces of the town. I have often thought that many quarries of ſtone upon examination would be found to owe their origin to the ſame cauſe, though

time

time may have effaced all ſigns of the volcano from whence they proceeded. Except this rock, which is evidently lava and full of vitrifications like that of Veſuvius, all the rocks upon the coaſt of Baïa are of *tufa*.

I have obſerved in the lava of Veſuvius and Etna, as in this, that the bottom as well as the ſurface of it was rough and porous, like the cinders or ſcoriæ from an iron foundery, and that for about a foot from the ſurface and from the bottom, they were not near ſo ſolid and compact as towards the centre; which muſt undoubtedly proceed from the impreſſion of the air upon the vitrified matter whilſt in fuſion. I mention this circumſtance, as it may ſerve to point out true lava's with more certainty. The ancient name of the Solfaterra was, *Forum Vulcani*, a ſtrong proof of its origin from ſubterraneous fire. The degree of heat that the Solfaterra has preſerved for ſo many ages, ſeems to have calcined the ſtones upon its cone, and in its crater, as they are very white and crumble eaſily in the hotteſt parts.

We come next to the new mountain near Puzzole, which, being of ſo very late a formation, preſerves its conical ſhape entire, and produces as yet but a very ſlender vegetation. It has a crater almoſt as deep as the cone is high, which may be near a quarter of a mile perpendicular, and is in ſhape a regular inverted cone. At the baſis of this new mountain (which is more than three miles in circumference), the ſand upon the ſea ſhore, and even that which is waſhed by the ſea itſelf, is burning hot for above the ſpace of an hundred yards; if you take up a handful of the

 ſand

ſand below water, you are obliged to get rid of it directly, on account of its intenſe heat.

I had been long very deſirous of meeting with a good account of the formation of this new mountain, becauſe, proving this mountain to have been raiſed by meer exploſion in a plain, would prove at the ſame time, that all the neighbouring mountains, which are compoſed of the ſame materials, and have exactly or in part the ſame form, were raiſed in the like manner, and that the ſeat of fire, the cauſe of theſe exploſions, lies deep, which I have every reaſon to think.

Fortunately, I lately found two very good accounts of the phænomena that attended the exploſion, which formed the new mountain, publiſhed a few months after the event. As I think them very curious, and greatly to my purpoſe, and as they are rare, I will give you a literal tranſlation of ſuch extracts as relate to the formation of the Monte Nuovo. They are bound in one volume *.

The title of the firſt is *Dell Incendio di Pozzuolo, Marco Antonio delli Falconi all Illuſtriſſima Signiora Marcheſa della Padula nel* MDXXXVIII.

At the head of the ſecond is, *Ragionamento del Terremoto, del Nuovo Monte, del Aprimento di Terra in Pozzuolo nell' Anno* 1538. *é della ſignificatione d'eſſi. Per Pietro Giacomo da Toledo*; and at the end of the book, *Stampata in Nap. per Giovanni Sulztbach Alemano, a 22di Genaro* 1539, *con gratia, é privilegio.*

" First then (ſays Marco Antonio delli Falconi), " will I relate ſimply and exactly the operations of

* This very ſcarce volume has been preſented by Mr. Hamilton to the Britiſh Muſeum. M. M.

" nature,

" nature, of which I was either myſelf an eye-wit-
" neſs, or as they were related to me by thoſe who
" had been witneſſes of them. It is now two years
" that there have been frequent earthquakes at
" Pozzuolo, at Naples, and the neighbouring parts;
" on the day, and in the night before the appearance
" of this eruption, above twenty ſhocks great and
" ſmall were felt at the abovementioned places. The
" eruption made its appearance the 29th of Septem-
" ber 1538, the feaſt of St Michael the angel; it was
" on a Sunday, about an hour in the night; and as I
" have been informed, they began to ſee on that ſpot,
" between the hot baths or ſweating rooms, and
" Trepergule, flames of fire, which firſt made their
" appearance at the baths, then extended towards
" Trepergule, and fixing in the little valley that lies
" between the Monte Barbaro and the hillock called
" del Pericolo (which was the road to the lake of
" Avernus and the baths), in a ſhort time the fire
" increaſed to ſuch a degree that it burſt open the
" earth in this place, and threw up ſo great a quanti-
" ty of aſhes and pumice ſtones mixed with water,
" as covered the whole country; and in Naples a
" ſhower of theſe aſhes and water fell great part of
" the night. The next morning, which was Monday,
" and the laſt of the month, the poor inhabitants of
" Pozzuolo, ſtruck with ſo horrible a ſight, quitted
" their habitations, covered with that muddy and
" black ſhower, which continued in that country the
" whole day, flying death, but with faces painted
" with its colours, ſome with their children in their
" arms, ſome with ſacks full of their goods, others
" leading an aſs loaded with their frightened family

" towards

" towards Naples, others carrying quantities of birds
" of various ſorts that had fallen dead at the time the
" eruption began, others again with fiſh which they
" had found, and were to be met with in plenty
" upon the ſhore, the ſea having been at that time
" conſiderably dried up. Don Petro di Toledo, Vice-
" roy of the kingdom, with many gentlemen, went
" to ſee ſo wonderful an appearance; I alſo, having
" met with the moſt honourable and incomparable
" gentleman, Signior Fabritio Moramaldo, on the
" road, went and ſaw the eruption and the many
" wonderful effects of it. The ſea towards Baïa
" had retired a conſiderable way; though from the
" quantity of aſhes and broken pumice ſtones thrown
" up by the eruption, it appeared almoſt totally dry.
" I ſaw likewiſe two ſprings in thoſe lately-diſcover-
" ed ruins, one before the houſe that was the queen's,
" of hot and ſalt water; the other of freſh and cold
" water, on the ſhore, about 250 paces nearer to the
" eruption: ſome ſay, that ſtill nearer to the ſpot
" where the eruption happened, a ſtream of freſh
" water iſſued forth like a little river. Turning to-
" wards the place of the eruption, you ſaw mountains
" of ſmoak, part of which was very black and part
" very white, riſe up to a great height; and in the
" midſt of the ſmoke, at times, deep-coloured flames
" burſt forth with huge ſtones and aſhes, and you
" heard a noiſe like the diſcharge of a number of
" great artillery. It appeared to me as if Typheus
" and Enceladus from Iſchia and Etna with inume-
" rable giants, or thoſe from the Campi Phlegrei
" (which according to the opinions of ſome were
" ſituated in this neighbourhood), were come to
" wage

" wage war again with Jupiter. The natural histo-
" rians may perhaps reasonably say, that the wise
" poets meant no more by giants, than exhalations,
" shut up in the bowels of the earth, which, not
" finding a free passage, open one by their own force
" and impulse, and form mountains, as those which
" occasioned this eruption have been seen to do;
" and methought I saw those torrents of burning
" smoke that Pindar describes in an eruption of Etna,
" now called mon Gibello in Sicily, in imitation of
" which, as some say, Virgil wrote these lines :

" *Ipse sed horrificis juxta tonat Ætna ruinis*, &c.

" After the stones and ashes with clouds of thick
" smoke had been sent up, by the impulse of the
" fire and windy exhalation (as you see in a great
" cauldron that boils), into the middle region of the
" air, overcome by their own natural weight, when
" from distance the strength they had received from
" impulse was spent, rejected likewise by the cold
" and unfriendly region, you saw them fall thick,
" and by degrees, the condensed smoke clear away,
" raining ashes with water and stones of different
" sizes, according to the distance from the place:
" then by degrees with the same noise and smoke it
" threw out stones and ashes again, and so on by
" fits. This continued two days and nights, when
" the smoke and force of the fire began to abate.
" The fourth day, which was Thursday at 22 o'clock,
" there was so great an eruption, that, as I was in
" the gulph of Puzzole coming from Ischia, and
" not far from Misenum, I saw, in a short time,
[illegible] many

" many columns of ſmoke ſhoot up, with the moſt " terrible noiſe I ever heard, and, bending over the " ſea, came near our boat, which was four miles or " more from the place of their birth; and the quan- " tity of aſhes, ſtones, and ſmoke, ſeemed as if they " would cover the whole earth and ſea. Stones, great " and ſmall, and aſhes more or leſs, according to the " impulſe of the fire and exhalations, began to fall, " ſo that a great part of this country was covered " with aſhes; and many that have ſeen it, ſay, they " reached the vale of Diana, and ſome parts of " Calabria, which are more than 150 miles from " Pozzuolo. The Friday and Saturday nothing but " a little ſmoke appeared, ſo that many, taking cou- " rage, went upon the ſpot, and ſay, that with the " ſtones and aſhes thrown up, a mountain has been " formed in that valley, not leſs than three miles in " circumference, and almoſt as high as the monte " Barbaro, which is near it, covering the Canettaria, " the caſtle of Trepergule, all thoſe buildings and " the greateſt part of the baths that were about " them; extending South towards the ſea, North as " far as the lake of Avernus, Weſt to the Sudatory, " and joining Eaſt to the foot of the monte Barbaro, " ſo that this place has changed its form and face in " ſuch a manner as not to be known again, a thing " almoſt incredible to thoſe who have not ſeen it, " that in ſo ſhort a time ſo conſiderable a mountain " could have been formed. On its ſummit there is a " mouth in the form of a cup, which may be a " quarter of a mile in circumference, though ſome " ſay it is as large as our market-place at Naples, from " which there iſſues a conſtant ſmoke; and though

" I have ſeen it only at a diſtance, it appears very " great. The Sunday following, which was the " 6th of October, many people going to ſee this " phænomenon, and ſome having aſcended half the " mountain, others more, about 22 o'clock there " happened ſo ſudden and horrid an eruption, with " ſo great a ſmoke, that many of theſe people were " ſtifled, ſome of which could never be found. I " have been told, that the number of the dead or " loſt amounted to twenty four. From that time " to this, nothing remarkable happened; it ſeems " as if the eruption returned periodically, like " the ague or gout. I believe henceforward it " will not have ſuch force, though the eruption " of the Sunday was accompanied with ſhowers " of aſhes and water, which fell at Naples, and " were ſeen to extend as far as the mountain of " Somma, called Veſuvius by the ancients; and, " as I have often remarked, the clouds of ſmoke " proceeding from the eruption, moved in a " direct line towards that mountain, as if theſe " places had a correſpondence and connection one " with the other. In the night, many beams and " columns of fire were ſeen to proceed from this " eruption, and ſome like flaſhes of lightening. " We have then, many circumſtances for our obſer- " vation, the earthquakes, the eruption, the drying " up of the ſea, the quantity of dead fiſh and birds, " the birth of ſprings, the ſhower of aſhes with " water, and without water, the innumerable trees " in that whole country, as far as the Grotto of " Lucullus, torn from their roots, thrown down, and " covered with aſhes, that it gave one pain, to ſee " them:

" them: and as all these effects were produced by " the same cause that produces earthquakes; let us " first enquire how earthquakes are produced, and " from thence we may easily comprehend the cause " of the abovementioned events." Then follows a dissertation on earthquakes, and some curious conjectures relative to the phænomena which attended this eruption, clearly and well expressed, considering, as the author himself apologizes, that at that time the Italian language had been little employed on such subjects.

The account of the formation of the monte Nuovo, by Pietro Giacomo di Toledo, is given in a dialogue between the feigned personages of Peregrino and Svessano; the former of which says, " It is now " two years that this province of Campagna has been " afflicted with earthquakes, the country about " Pozzuolo much more so than any other parts, but " the 27th and the 28th of the month of September " last, the earthquakes did not cease day or night, in " the abovementioned city of Pozzuolo; that plain " which lies between the lake of Averno, the monte " Barbaro, and the sea, was raised a little, and many " cracks were made in in it, from some of which " issued water; and at the same time the sea, which " was very near the plain, dried up about two hun- " dred paces, so that the fish were left on the sand, " a prey to the inhabitants of Pozzuolo. At last, on " the 29th of the said month, about two hours in " the night, the earth opened near the lake, and dis- " covered a horrid mouth, from which were vomited " furiously, smoke, fire, stones, and mud composed " of ashes; making, at the time of its opening, a

" noise

" noiſe like very loud thunder: the fire that iſſued " from this mouth, went towards the walls of the " unfortunate city; the ſmoke was partly black and " partly white, the black was darker than darkneſs " itſelf, and the white was like the whiteſt cotton; " theſe ſmokes, riſing in the air, ſeemed as if they " would touch the vault of heaven; the ſtones that " followed, were, by the devouring flames, con- " verted to pumice, the ſize of which (of ſome I ſay) " were much larger than an ox. The ſtones went " about as high as a croſs-bow can carry, and then " fell down, ſometimes on the edge and ſometimes " into the mouth itſelf. It is very true that many of " them in going up could not be ſeen, on account " of the dark ſmoke; but when they returned from " the ſmoky heat, they ſhewed plainly where they " had been by their ſtrong ſmell of fetid ſulphur, " juſt like ſtones that have been thrown out of a " mortar, and have paſſed through the ſmoke of in- " flamed gunpowder. The mud was of the colour " of aſhes, and at firſt very liquid, then by degrees " leſs ſo, and in ſuch quantities, that in leſs than " twelve hours, with the help of the abovementioned " ſtones, a mountain was raiſed of a thouſand paces " in height. Not only Pozzuolo and the neighbour- " ing country was full of this mud, but the city of " Naples alſo, the beauty of whoſe palaces were, in " a great meaſure, ſpoiled by it. The aſhes were " carried as far as Calabria by the force of the " winds, burning up in their paſſage the graſs and " high trees, many of which were borne down by the " weight of them. An infinity of birds alſo, and " numberleſs animals of various kinds, covered with

" this ſulphureous mud, gave themſelves up a prey " to man. Now this eruption laſted two nights and " two days without intermiſſion, though, it is true, " not always with the ſame force, but more or leſs; " when it was at its greateſt height, even at Naples " you heard a noiſe or thundering like heavy artillery " when two armies are engaged. The third day " the eruption ceaſed, ſo that the mountain made its " appearance uncovered, to the no ſmall aſtoniſh- " ment of every one who ſaw it. On this day, " when I went up with many people to the top of " this mountain; I ſaw down into its mouth, which " was a round concavity of about a quarter of a mile " in circumference, in the middle of which the " ſtones that had fallen were boiling up, juſt as in " a great cauldron of water that boils on the fire. " The fourth day it began to throw up again, and " the ſeventh much more, but ſtill with leſs violence " than the firſt night; it was at this time that many " people, who were unfortunately on the mountain, " were either ſuddenly covered with aſhes, ſmothered " with ſmoke, or knocked down by ſtones, burnt by " the flame, and left dead on the ſpot. The ſmoke " continues to this day, and you often ſee in the night " time fire in the midſt of it. Finally, to complete " the hiſtory of this new and unforeſeen event; in " many parts of the new-made mountain, ſulphur " begins to be generated." Giacomo di Toledo, towards the end of his diſſertation upon the phæno-mena attending this eruption, ſays, that the lake of Avernus had a communication with the ſea, before the time of the eruption; and that he apprehended that the air of Puzzole might come to be affected in

ſummer

fummer time, by the vapours from the ftagnated waters of the lake, which is actually the cafe.

You have, Sir, from thefe accounts, an inftance of a mountain, of a confiderable height and dimenfions, formed in a plain, by mere explofion, in the fpace of forty-eight hours. The earthquakes having been fenfibly felt at a great diftance from the fpot where the opening was made, proves clearly, that the fubterraneous fire was at a great depth below the furface of the plain; it is as clear that thofe earthquakes, and the explofion, proceeded from the fame caufe, the former having ceafed upon the appearance of the latter. Does not this circumftance evidently contradict the fyftem of M. Buffon, and of all the natural hiftorians, who have placed the feat of the fire of volcanos towards the center, or near the fummit of the mountains, which they fuppofe to furnifh the matter emitted? Did the matter which proceeds from a volcano in an eruption come from fo inconfiderable a depth as they imagine, that part of the mountain fituated above their fuppofed feat of the fire muft neceffarily be deftroyed, or diffipated in a very fhort time: on the contrary, an eruption ufually adds to the height and bulk of a volcano, and who, that has had an opportunity of making obfervations on volcanos does not know, that the matter they have emitted for many ages, in lavas, afhes, fmoke, &c. could it be collected together, would more than fuffice to form three fuch mountains as the fimple dome or mountain of the exifting volcano? With refpect to Vefuvius, this could be plainly proved; and I refer to my letter upon the fubject of Etna, to fhew the quantity of matter thrown up in one fingle eruption,

tion, by that terrible volcano. Another proof that the real ſeat of the fire of volcanos lies even greatly below the general level of the country whence the mountain ſprings, is, that was it only at an inconſiderable depth below the baſis of the mountain, the quantity of matter thrown up would ſoon leave ſo great a void immediately under it, that the mountain itſelf muſt undoubtedly ſink and diſappear after a few eruptions.

In the above accounts of the formation of the new mountain, we are told that the matter firſt thrown up, was mud compoſed of water and aſhes, mixed with pumice ſtones and other burnt matter: on the road leading from Puzzole to Cuma, part of the cone of this mountain has been cut away to widen the road. I have there ſeen that its compoſition is a *tufa* intermixed with pumice, ſome of which are really of the ſize of an ox, as mentioned in Toledo's account, and exactly of the ſame nature as the *tufa* of which every other high ground in its neighbourhood is compoſed; ſimilar alſo to that which covers Herculaneum. According to the above accounts, after the muddy ſhower ceaſed, it rained dry aſhes: this circumſtance will account for the ſtrata of looſe pumice and aſhes, that are generally upon the ſurface of all the *tufas* in this country, and which were moſt probably thrown up in the ſame manner. At the firſt opening of the earth, in the plain near Puzzole, both accounts ſay, that ſprings of water burſt forth; this water, mixing with the aſhes, certainly occaſioned the muddy ſhower; when the ſprings were exhauſted, there muſt naturally have enſued a ſhower of dry aſhes and pumice, of which we have been

likewiſe aſſured. I own, I was greatly pleaſed at being in this manner enabled to account ſo well for the formation of theſe *tufa* ſtones and the veins of dry and looſe burnt matter above them, of which the ſoil of almoſt the whole country I am deſcribing is compoſed; and I do not know that any one has ever attended to this circumſtance, though I find that many authors, who have deſcribed this country, have ſuſpected that parts of it were formed by exploſion. Wherever then this ſort of *tufa* is found, there is certainly good authority to ſuſpect its having been formed in the ſame manner as the *tufa* of this new mountain; for, as I ſaid before, nature is generally uniform in all her operations.

It is commonly imagined that the new mountain roſe out of the Lucrine lake which was deſtroyed by it; but in the above account, no mention is made of the Lucrine lake; it may be ſuppoſed then, that the famous dam, which Strabo and many other ancient authors mention to have ſeparated that lake from the ſea, had been ruined by time or accident, and that the lake became a part of the ſea before the exploſion of 1538.

If the above deſcribed eruption was terrible, that which formed the monte Barbaro (or Gauro, as it was formerly called), muſt have been dreadful indeed. It joins immediately to the new mountain, which in ſhape and compoſition it exactly reſembles; but it is at leaſt three times as conſiderable. Its crater cannot be leſs than ſix miles in circumference; the plain within the crater, one of the moſt fertile ſpots I ever ſaw, is about four miles in circumference; there is no entrance to this plain, but one on the Eaſt

Eaſt ſide of the mountain, made evidently by art; in this ſection you have an opportunity of ſeeing that the matter, of which the mountain is compoſed is exactly ſimilar to that of the monte Nuovo. It was this mountain that produced (as ſome authors have ſuppoſed) the celebrated Falernian wine of the ancients.

Cuma, allowed to have been the moſt ancient city of Italy, was built on an eminence, which is likewiſe compoſed of *tufa*, and may be naturally ſuppoſed a ſection of the cone formed by a very ancient exploſion.

The lake of Avernus fills the bottom of the crater of a mountain, undoubtedly produced by exploſion, and whoſe interior and exterior form, as well as the matter of which it is compoſed, exactly reſemble the monte Barbaro and monte Nuovo. At that part of the baſis of this mountain which is waſhed by the ſea of the bay of Puzzole, the ſand is ſtill very hot, though conſtantly waſhed by the waves; and into the cone of the mountain, near this hot ſand, a narrow paſſage of about 100 paces in length is cut, and leads to a fountain of boiling water, which, though brackiſh, boils fiſh and fleſh without giving them any bad taſte or quality, as I have experienced more than once. This place is called Nero's bath, and is ſtill made uſe of for a ſudatory, as it was by the ancients; the ſteam that riſes from the hot fountain abovementioned, confined in the narrow ſubterraneous paſſage, ſoon produces a violent perſpiration upon the patient who ſits therein. This bath is reckoned a great ſpecifick in that diſtemper which is ſuppoſed to have

made its appearance at Naples, before it ſpread its contagion over the other parts of Europe.

Virgil and other ancient authors ſay, that birds could not fly with ſafety over the lake of Avernus, but that they ſell therein; a circumſtance favouring my opinion that this was once the mouth of a volcano. The vapour of the ſulphur and other minerals muſt undoubtedly have been more powerful the nearer we go back to the time of the exploſion of the volcano; and I am convinced that there are ſtill ſome remains of thoſe vapours upon this lake, as I have obſerved there are very ſeldom any water fowl upon it; and that when they do go there, it is but for a ſhort time, whilſt all the other lakes in the neighbourhood are conſtantly covered with them, in the winter ſeaſon. Upon mount Veſuvius, in the year 1766, during an eruption, when the air was impregnated with noxious vapours, I have myſelf picked up dead birds frequently.

The caſtle of Baïa ſtands upon a conſiderable eminence, compoſed of the uſual *tufa* and ſtrata of pumice and aſhes, from which I concluded I ſhould find ſome remains of the craters from whence the matter iſſued; accordingly, having aſcended the hill, I ſoon diſcovered two very viſible craters, juſt behind the caſtle.

The lake called the Mare morto was alſo, moſt probably, the crater from whence iſſued the materials which formed the Promontory of Miſenum, and the high grounds around this lake. Under the ruins of an ancient building near the point of Miſenum, in a vault, there is a vapour, or *moſete*, exactly ſimilar in its

its effects to that of the Grotto del Cane, as I have often experienced.

The form of the little iſland of Niſida ſhews plainly its origin. It is half a hollow cone of a volcano cut perpendicularly; the half crater forms a little harbour called the Porto Pavone; I ſuppoſe the other half of the cone to have been detached into the ſea by earthquakes, or perhaps by the violence of the waves, as the part that is wanting is the ſide next to the open ſea.

The fertile and pleaſant iſland of Procita ſhews alſo moſt evident ſigns of its production by exploſion, the nature of its ſoil being directly ſimilar to that of Baïa and Puzzole; this iſland ſeems really, as was imagined by the ancients, to have been detached from the neighbouring iſland of Iſchia.

There is no ſpot, I believe, that could afford a more ample field for curious obſervations, than the iſland of Iſchia, called Enaria, Inarime, and Pithecuſa, by the ancients. I have viſited it three times; and this ſummer paſſed three weeks there, during which time, I examined, with attention, every part of it. Iſchia is eighteen miles in circumference: the whole of its ſoil is the ſame as that near Veſuvius, Naples, and Puzzole. There are numberleſs ſprings, hot, warm, and cold, diſperſed over the whole iſland, the waters of which are impregnated with minerals of various ſorts; ſo that, if you give credit to the inhabitants of the country, there is no diſorder but what finds its remedy here. In the hot months (the ſeaſon for making uſe of theſe baths), thoſe who have occaſion for them flock hither from Naples.

A chari-

A charitable inftitution fends and maintains three hundred poor patients at the baths of Gurgitelli every feafon. By what I could learn of thefe poor patients, thofe baths have really done wonders, in cafes attended with obftinate tumours, and in contractions of the tendons and mufcles. The patient begins by bathing, and then is buried in the hot fand near the fea. In many parts of the ifland, the fand is burning hot, even under water. The fand on fome parts of the fhore is almoft entirely compofed of particles of iron ore; at leaft they are attracted by the load-ftone, as I have experienced. Near that part of the ifland called Lacco, there is a rock of an ancient lava, forming a fmall cavern, which is fhut up with a door; this cavern is made ufe of to cool liquors and fruit, which it does in a fhort time as effectually as ice. Before the door was opened, I felt the cold to my legs very fenfibly; but when it was opened, the cold rufhed out fo as to give me pain, and within the grotto it was intolerable. I was not fenfible of wind attending this cold; though upon mount Etna and mount Vefuvius, where there are caverns of this kind, the cold is evidently occafioned by a fubterraneous wind: the natives call fuch places *ventaroli*. May not the quantity of nitre, with which all thefe places abound, account in fome meafure for fuch extreme cold? My thermometer was unluckily broken, or I would have informed you of the exact degree of the cold in this *ventaroli* of Ifchia, which is by much the ftrongeft in its effects I ever felt. The ancient lavas of Ifchia fhew, that the eruptions there have been very formidable; and hiftory informs us, that its firft inhabitants were driven out of the ifland

 by

by the frequency and the violence of them. There are ſome of theſe ancient lavas not leſs than two hundred feet in depth. The mountain of St. Nicola, on which there is at preſent a convent of hermits, was called by the ancients Epomeus; it is as high, if not higher, than Veſuvius, and appears to me to be a ſection of the cone of the ancient and principal volcano of the iſland, its compoſition being all *tufa* or lava. The cells of the convent abovementioned are cut out of the mountain itſelf; and there you ſee plainly that its compoſition no way differs from the matter that covers Herculaneum, and forms the monte Nuovo. There is no ſign of a crater on the top of this mountain, which riſes almoſt to a ſharp point; time, and other accidents, may be reaſonably ſuppoſed to have worn away this diſtinctive mark of its having been formed by exploſion, as I have ſeen to be the caſe in other mountains, formed evidently by exploſion, on the flanks of Etna and Veſuvius. Strabo, in his 5th book, upon the ſubject of this iſland, quotes Timæus, as having ſaid, that, a little before his time, a mountain in the middle of Pithecuſa, called Epomeus, was ſhook by an earthquake, and vomited flames.

There are many other riſing grounds in this iſland, that, from the nature of their compoſition, muſt lead one to think the ſame as to their origin. Near the village of Caſtiglione, there is a mountain formed ſurely by an exploſion of a much later date, having preſerved its conical form and crater entire, and producing as yet but a ſlender vegetation: there is no account, however, of the date of this eruption. Nearer the town of Iſchia, which is on the ſea ſhore,

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at a place called *Le Cremate*, there is a crater, from which, in the year 1301 or 1302, a lava ran quite into the ſea; there is not the leaſt vegetation on this lava, but it is nearly in the ſame ſtate as the modern lavas of Veſuvius. Pontano, Maranti, and D. Franceſco Lombardi, have recorded this eruption; the latter of whom ſays, that it laſted two months, that many men and beaſts were killed by the exploſion, and that a number of the inhabitants were obliged to ſeek for refuge at Naples and in the neighbouring iſlands. In ſhort, according to my idea, the iſland of Iſchia muſt have taken its riſe from the bottom of the ſea, and been increaſed to its preſent ſize by divers later exploſions. This is not extraordinary, when hiſtory tells us (and from my own obſervation I have reaſon to believe) that the Lipary iſlands were formed in the like manner. There has been no eruption in Iſchia ſince that juſt mentioned, but earthquakes are very frequent there; two years ago, as I was told, they had a very conſiderable ſhock of an earthquake in this iſland.

Father Goree's account of the formation of the new iſland in the Archipelago (ſituated between the two iſlands called Kammeni, and near that of Santorini) of which he was an eye-witneſs, ſtrongly confirms the probability of the conjectures I venture to ſend you, relative to the formation of thoſe iſlands and that part of the continent above deſcribed: it ſeems likewiſe to confirm the accounts given by Strabo, Pliny, Juſtin, and other ancient authors, of many iſlands in the Archipelago, formerly called the Cicladdes, having ſprung up from the bottom of the ſea in the like manner. According to Pliny, in the

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4th year of the cxxxv Olympiad, 237 years before the Christian æra, the island of Thera (now Santorini) and Theresia were formed by explosion; and, 130 years later, the island Hiera (now called the great Kammeni) rose up. Strabo describes the birth of this island in these words: "In the middle space between "Thera and Therasia flames burst out of the sea for "four days, which, by degrees, throwing up great "masses, as if they had been raised by machines, "they formed an island of twelve stadia in circuit." And Justin says of the same island, *Eodem anno inter insulas Theramenem et Theresiam, medio utriusque ripæ et maris spatio, terræ motus fuit: in quo, cum admiratione navigantium, repente ex profundo cum calidis aquis Insula emersit.*

Pliny mentions also the formation of Aspronisi, or the White Island, by explosion, in the time of Vespasian. It is known, likewise, that in the year 1628, one of the islands of the Azores, near the island of St. Michael, rose up from the bottom of the sea, which was in that place 160 fathoms deep; and that this island, which was raised in fifteen days, is three leagues long, a league and a half broad, and rises three hundred and sixty feet above water.

Father Goree, in his account of the formation of the new island in the Archipelago, mentions two distinct matters that entered into the composition of this island, the one black, the other white. Aspronisi, probably from its very name, is composed of the white matter, which if, upon examination, should prove to be a *tufa*, as I strongly suspect, I should think myself still more grounded in my conjectures; though I must confess, as it is, I have scarcely a doubt

doubt left with reſpect to the country I have been deſcribing having been thrown up in a long ſeries of ages by various exploſions from ſubterraneous fire. Surely there are at preſent many exiſting volcanos in the known world; and the memory of many others have been handed down to us by hiſtory. May there not therefore have been many others of ſuch ancient dates as to be out of the reach of hiſtory?

Such wonderful operations of nature are certainly intended by all-wiſe Providence for ſome great purpoſe. They are not confined to any one part of the globe, for there are volcanos exiſting in the four quarters of it. We ſee the great fertility of the ſoil thrown up by exploſion, in part of the country I have deſcribed, which on that account was called by the ancients *Campania Felix*. The ſame circumſtance is evident in Sicily, juſtly eſteemed one of the moſt fertile ſpots in the world, and the granary of Italy. May not ſubterraneous fire be conſidered as the great plough (if I may be allowed the expreſſion) which nature makes uſe of to turn up the bowels of the earth, and afford us freſh fields to work upon, whilſt we are exhauſting thoſe we are actually in poſſeſſion of, by the frequent crops we draw from them? Would it not be found, upon enquiry, that many precious minerals muſt have remained far out of our reach, had it not been for ſuch operations of nature? It is evidently ſo in this country. But ſuch great enquiries would lead me far indeed. I will only add a reflection, which my own little experience in this branch of natural hiſtory furniſhes me with. It is, that we are apt to judge of the great operations of nature on too confined a plan. When firſt I came to Naples, my

my whole attention, with reſpect to natural hiſtory, was confined to mount Veſuvius, and the wonderful phænomena attending a burning mountain; but, in proportion as I began to perceive the evident marks of the ſame operation having been carried on in the different parts above deſcribed, and likewiſe in Sicily, in a greater degree, I looked upon mount Veſuvius only as a ſpot on which nature was at preſent active, and thought myſelf fortunate in having an opportunity of ſeeing the manner in which one of her great operations (an operation, I believe, much leſs out of her common courſe than is generally imagined) was effected.

Such remarks as I have made on the eruptions of mount Veſuvius, during my reſidence at Naples, have been tranſmitted to the Royal Society, who have done them more honour than they deſerved. Many more might be made upon this active volcano, by a perſon who had leiſure, a previous knowledge of the natural hiſtory of the earth, a knowledge of chemiſtry, and was practiſed in phyſical experiments, particularly thoſe of electricity. I am convinced that the ſmoke of volcanos contains always a portion of electrical matter, which is manifeſt at the time of great eruptions, as is mentioned in my account of the great eruption of Veſuvius in 1767. The peaſants in the neighbourhood of my villa, ſituated at the foot of Veſuvius, have aſſured me, that, during the eruption laſt mentioned, they were more alarmed by the lightening and balls of fire that fell about them with a crackling noiſe, than by the lava and the uſual attendants of an eruption. I find in all the accounts of great eruptions mention made of this ſort of

lightening,

lightening which is diſtinguiſhed here by the name of *Ferilli*. Bracini, in his account of the great one of Veſuvius in 1631, ſays, that the column of ſmoke, which iſſued from its crater, went over near an hundred miles of country, and that ſeveral men and beaſts were ſtruck dead by lightening, iſſuing from this ſmoke in its courſe.

The nature of the noxious vapours, called here *mofete*, that are uſually ſet in motion by an eruption of the volcano, and are then manifeſt in the wells and ſubterraneous parts of its neighbourhood, ſeem likewiſe to be little underſtood. From ſome experiments very lately made, by the ingenious Dr. Nuth, on the *mofete* of the Grotto del Cane, it appears that all its known qualities and effects correſpond with thoſe attributed to fixed air. Juſt before the eruption of 1767, a vapour of this kind broke into the king's chapel at Portici, by which a ſervant, opening the door of it, was ſtruck down. About the ſame time, as his Sicilian majeſty was ſhooting in a paddock near the palace, a dog dropped down, as was ſuppoſed, in a fit; a boy going to take him up dropped likewiſe; a perſon preſent, ſuſpecting the accident to have proceeded from a *mofete*, immediately dragged them both from the ſpot where they lay, in doing which, he was himſelf ſenſible of the vapour; the boy and the dog ſoon recovered. His Sicilian majeſty did me the honour of informing me himſelf of this accident ſoon after it had happened. I have met with theſe *mofetes* often, when I have been making my obſervations on the borders of mount Veſuvius,

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particularly in caverns, and once on the Solfaterra. The vapour affects the nostrils, throat, and stomach, just as the spirit of hartshorn, or any strong volatile salts, and would soon prove fatal if you did not immediately remove from it. Under the ancient city of Pompeii, the *mofetes* are very frequent and powerful, so that the excavations that are carrying on there are often interrupted by them; at all times *mofetes* are to be met with under ancient lavas of Vesuvius, particularly those of the great eruption of 1631. In Serao's account of the eruption of 1737, and in the chapter upon *mofetes*, he has recorded several curious experiments relative to this phænomenon. The Canonico Recupero, who, as I mentioned to you in a former letter, is watching the operations of mount Etna, has just informed me, that a very powerful *mofete* has lately manifested itself in the neighbourhood of Etna; and that he found near the spot from whence it rises, animals, birds, and insects, dead, and the stronger sort of shrubs blasted, whilst the grass and tenderer plants did not seem to be affected. The circumstance of this *mofete*, added to that of the frequent earthquakes felt lately at Rhegio and Messina, makes it probable that an eruption of mount Etna is at hand.

I am alarmed at the length of this letter. By endeavouring to make myself clearly understood, I have been led to make, what I thought, necessary digressions. I must therefore beg of your goodness, that, should you find this memoir in its present state, too tedious (which I greatly apprehend) to be pre-

ſented to our reſpectable Society, you will make only ſuch extracts from it as you ſhall think will be moſt agreeable and intereſting. I am,

SIR,

With great truth and regard,

Your moſt obedient humble ſervant,

William Hamilton.

References to the Map, Tab. I.

1. Naples.
2. Portici.
3. Refina, under which Herculaneum is buried.
4. Torre del Greco.
5. Hermitage, at which travellers ufually reft, in their way up mount Vefuvius.
6. St. Angelo, a convent of Calmaldolefe, fituated upon a cone of a mountain formed by an ancient explofion.
7. Cones formed by the eruption of 1760, and lava that ran from them almoft into the fea.
8. Mount Vefuvius and Somma.
9. Village of Somma.
10. The convent of the Madona del Arco, under which lavas have been found at 300 feet depth, and which muft have proceeded from the mountain of Somma, when an active volcano.
11. Ottaiano.
12. Torre del Annunziata.
13. Caftel a Mare, near which the ancient town of Stabia is buried, and where Pliny the elder loft his life.
14. Vico.
15. Sorrento, and the plain formed evidently by fubterraneous fire.
16. Maffa.
17. Ifland of Caprea.

18. The Grotto of Paufilipo, cut through the mountain anciently, to make a road from Naples to Puzzole.
19. Point of Paufilipo.
20. The Gaiola, where there are ruins of ancient buildings, fuppofed to have belonged to Lucullus.
21. The ifland of Nifida, evidently formed by explofion.
22. The Lazaret.
23. The Bagnoli.
24. Puzzole, or Pozzuolo.
25. The Solfaterra, anciently called Forum Vulcani: between the Solfaterra and the lake of Agnano, are the boiling waters of the Pifciarelli.
26. The New Mountain, formed by explofion in the year 1538; the fand of the fea fhore at its bafis burning hot.
27. The lake of Agnano, fuppofed the crater of an ancient volcano: here are the baths called St. Germano, and the famous Grotto del Cane.
28. Aftruni, which has been evidently a volcano, and is now a Royal Chace, the crater being furrounded with a wall.
29. The monte Gauro or Barbaro, anciently a volcano.
30. The lake of Avernus, evidently the crater of an ancient volcano.
31. Lake of Fufaro.
32. Point of Mifenum, from whence Pliny the elder difcovered the eruption of Vefuvius that proved fatal to him; near this place, in a vault of an ancient building, is a conftant vapour

or

or *mofete*, of the ſame quality with that of the Grotto del Cane.

33. The Mare Morto, the ancient Roman Harbour.

34. Baïa; behind the caſtle are two evident craters of ancient volcanos.

35. Iſland of Procita.

36. A perfect cone and crater of a volcano near Caſtiglione in the iſland of Iſchia.

37. Lava that ran into the ſea in the laſt eruption on this iſland, in the year 1301, or 1302; the place now called Le Cremate.

38. Town of Iſchia and caſtle.

39. Lake of Licola.

40. Lake of Patria.

41. The river Volturnus.

42. Capua.

43. Caſerta.

44. Averſa.

45. Mataloni.

46. Acerra.

47. Iſland of Iſchia, anciently called Ænaria, Inarime, and Pithecuſa.

48. The mountain of St. Nicola, anciently called Mons Epomeus, ſuppoſed the remains of the principal volcano of the iſland.

49. Caſtiglione, near which are the baths of Gurgitelli.

50. Lacco, near which is that very cold vapour called by the natives *ventarole*.

51. Ancient city of Pompeii, where his Sicilian majeſty's excavations are carrying on at preſent.

52. Rovigliano.

53. River of Sarno.

54. Cuma.
55. Hot ſands and Sudatory called Nero's baths.
56. The Lucrine lake ſuppoſed to have been here, and of which there is ſtill ſome little remain.
57. Villa Angelica, Mr. Hamilton's villa, from whence he has made many of his obſervations upon mount Veſuvius.
58. Cones formed by an ancient eruption called *viuli*; here are likewiſe cold vapours called *ventaroli*.
59. High grounds, probably ſections of cones of ancient volcanos, being all compoſed of *tufa* and ſtrata of looſe pumice and burnt matter.
60. Plain of the Campagna Felice, four or five feet of excellent ſoil, under which are ſtrata of burnt and erupted matter.
: . . . . . Marks the boundary of Mr. Hamilton's obſervations.

II. *Extract of another Letter, from Mr.* Hamilton, *to Dr.* Maty, *on the same Subject.*

Naples, March 5, 1771.

Read May 30, 1771.

SINCE I had the pleasure of sending you my letter, in which the nature of the soil of more than twenty miles round this capital is described; examining a deep hollow way cut by the rain waters into the outside cone of the Solfaterra, I discovered, that a great part of the cone of that ancient volcano has been calcined by the hot vapours above described. Pumice calcined seems to be the chief ingredient, of which several specimens of (as I suppose) variegated uniform marble are composed, and the beautiful variegations in them may have probably been occasioned by the mineral vapours. As these specimens are now sent to the Royal Society, you will see that these variegations are exactly of the same pattern and colours as are met in many marbles and flowered alabasters; and I cannot help thinking that they are marble or alabaster in its infant state. What a proof we have here of the great changes the earth we inhabit is subject to! What is now the Solfaterra, we have every reason to suppose, to have been originally thrown up by a subterraneous explosion from the bottom of the sea. That it was long

an exiſting volcano, is plain, from the ancient currents of lava, that are ſtill to be traced from its crater to the ſea, from the ſtrata of pumice and erupted matter, of which its cone, in common with thoſe of all other volcanos, is compoſed, and from the teſtimony of many ancient authors. Its cone in many parts has been calcined, and is ſtill calcining, by the hot vapours that are continually iſſuing forth through its pores, and its nature is totally changed by this chemical proceſs of nature. In the hollow way, where I made theſe remarks, you ſee the different ſtrata of erupted matter, that compoſe the cone in ſome places perfectly calcined, in others not, according as the vapours have found means to inſinuate themſelves more or leſs.

A hollow way cut by the rains on the back of the mountain, on which part of Naples is ſituated, towards Capo di China, ſhews that the mountain is compoſed of ſtrata of erupted matter, among which are large maſſes of bitumen, in which its former ſtate of fluidity is very viſible. Here it was I diſcovered that pumice ſtone is produced from bitumen, which I believe has not yet been remarked. Some ſpecimens ſhew evidently the gradual proceſs from bitumen to pumice; and you will obſerve that the cryſtalline vitrifications, that are viſible in the bitumen, ſuffer no alteration, but remain in the ſame ſtate in the perfect pumice as in the bitumen.

In a piece of ſtratum, calcined from the outſide of the Solfaterra, the form and texture of the pumice ſtones is very diſcernible. In ſeveral parts of the outſide cone, this calcining operation is ſtill carried on by the exhalation of conſtant very hot

 and

and damp vapours, impregnated with ſalts, ſulphur, alum, &c. Where the above-mentioned vapours have not operated, the ſtrata of pumice and erupted matter, that compoſe the cone of the Solfaterra, are like thoſe of all the high grounds in its neighbourhood, which I ſuppoſe to have been thrown up likewiſe by exploſion. I have ſeen here, half of a large piece of lava perfectly calcined, whilſt the other half out of the reach of the vapours has been untouched; and in ſome pieces the center ſeems to be already converted into true marble.

The variegated ſpecimens then, above deſcribed, are nothing more than pumice and erupted matter, after having been acted upon in this manner by the hot vapours; and if you conſider the proceſs, as I have traced it, from bitumen to pumice, and from pumice to marble, you will think with me that it is difficult to determine the primitive ſtate of the many wonderful productions we ſee in nature.

I found in the *tufa* of the mountain of Pauſilipo, a fragment* of lava: one ſide I poliſhed, to ſhew it to be true lava; the other ſhews the ſigns of the *tufa*, with which it is incorporated. It has evidently been rounded by friction, and moſt probably by rolling in the ſea. Is it not natural then to imagine that there muſt have been volcanoes near this ſpot, long before the formation of the mountain of Pauſilipo? This little ſtone may perhaps raiſe in your mind ſuch reflections, as it did in mine, relative to the great changes our globe ſuffers, and the probability of its great antiquity.

III. A

III. *A Letter from Dr.* Franklyn, *F. R. S. to the Aſtronomer Royal; containing an Obſervation of the Tranſit of* Mercury *over the* Sun, November 9*th* 1769: *By* John Winthrop, *Eſq; F. R. S.* Hollifian *Profeſſor of Mathematics and Natural Philoſophy at* Cambridge, New England.

DEAR SIR,

Craven-ſtreet, Feb. 12, 1770.

Read Jan. 10, 1771.

I HAVE juſt received a letter from Mr. Winthrop, dated Dec. 7, containing the following account, *viz.*

" On Thurſday the 9th of November, I had an " opportunity of obſerving a tranſit of Mercury. I " had carefully adjuſted my clock to the apparent " time, by correſpondent altitudes of the Sun, taken " with the quadrant for ſeveral days before, and with " the ſame reflecting teleſcope as I uſed for the tranſit " of Venus *. I firſt perceived the little planet " making an impreſſion on the Sun's limb at $2^h\ 52'$ " $41''$; and he appeared wholly within at $53'\ 58''$ " apparent time. The ſun ſet before the planet " reached the middle of his courſe; and for a con-

* See Phil. Tranſact. Vol. LIX. p. 352.

 " ſiderable

" ſiderable time before ſunſet, it was ſo cloudy, that
" the planet could not be diſcerned. So that I made
" no obſervations of conſequence except that of the
" beginning, at which time the Sun was perfectly
" clear. This tranſit compleats three periods of
" 46 years, ſince the firſt obſervation of Gaſſendi at
" Paris, in 1631."

I am, SIR,

With great eſteem,

Your moſt obedient ſervant,

B. Franklin.

IV. *Obſervations on the Heat of the Ground on Mount* Veſuvius: *By* John Howard, *Eſq; F. R. S.*

Read Jan. 17, 1771.

I BEG leave to lay before this Society, ſome obſervations which I made laſt June, on the heat of the ground on mount Veſuvius, near Naples.

On my aſcending the mountain, I often immerged the bulb of a thermometer in the ground, but found no ſenſible heat for ſome time: the firſt riſing in my thermometer, was 114°; every two or three minutes, I obſerved the inſtrument, till I gained the ſummit. At thoſe times, I found it riſing to 122°, 137°, 147°, 164°, and 172°: on the top, in two places, where I made the obſervations, in the interſtices betwixt the hard lava, it was 218°. Such a degree of heat, after I had overcome the inconvenience of the exhalations, raiſed my curioſity to know if there was a ſtill greater degree of heat in the mouth of the ſaid mountain. Accordingly, I made a ſmall deſcent, and, by two obſervations I carefully and attentively made, my thermometer both times ſtood at 240°.

John Howard.

P. S. It

P. S. If it ſhould be aſked, how a perſon, either to their feet or in ſtooping or laying down to make the obſervations, could endure ſuch a degree of heat; I anſwer, that the heat, both at top and in the mouth of the mountain, was only in particular places. This was known by the fumes; the hard maſſes of lava are only warm, and even ſo tolerable as to permit me, to lay on them, as I was often obliged to do, when the thermometer was immerged, to make a true obſervation.

Philos. Trans. Vol. LXI. Tab. II. p. 55.

G. Edwards delineavit A°. [illegible]

V. *Defcription of a Bird from the* Eaft Indies; *in a Letter to* James Weft, *Efq; Prefident of the Royal Society; from Mr.* George Edwards, *F. R. S.*

SIR,

Read Jan. 17, 1771.

IN Auguft laft, a friend of mine carried me with him to Valentine Houfe, near Ilford in Effex, the feat of Charles Raymond, Efq; to fee fome curious birds and other animals, from the Eaft Indies; amongft thefe, I difcovered a rare bird, not before known to me *. It is of a new genus, and the only fpecies of the genus hitherto come to my knowledge. It is about the bignefs of a heron [fee TAB. II.]; and has a good deal of the appearance of birds of the heron and crane kind, except that the neck is a little fhorter. On firft fight, I thought the bird belonged to that genus; but, on a clofer view, I judged it to be no wader in the water, for though the legs be as long or longer than in herons, &c. yet they are feathered down to the knees, which we do not find in birds who wade in fhallow waters, to feek their food.

* This bird was defcribed, under the name of the *Sagittarius* from the Cape of good Hope, by Mr. Vofmaer, keeper of the Statholder's Mufeum at the Hague, in one of his publications in low Dutch, printed at Amfterdam, 1769, in 4to, with a coloured cut of the faid bird. It feems to feed equally on flefh and fifh; which accounts for his uniting the characters of birds of prey, and of waders in water. M. M.

food. The toes in this bird are alſo much ſhorter than they are in herons, ſo that I think it muſt be placed amongſt land birds. The bill is exactly like thoſe of hawks, and other birds of prey, which is the only inſtance I have diſcovered in any of the long legged kind of birds; the talons or claws are ſmall and unfit for a bird of prey, and the eyes are of a dark colour placed in ſpaces covered with a bare ſkin of an orange colour, on each ſide of the head. It hath a beautiful creſt compoſed of many long painted feathers tipped with black hanging backward. The beak, head, neck, back, breaſt, and upper covert feathers of the wings are of a blueiſh aſh colour, rather lighter on the breaſt than on the back. The belly, thighs, the greater wing-feathers, and tail, are black, the tail feathers being tipped with white; the legs and feet are of a reddiſh fleſh colour, the claws black. This bird was called a ſnake-eater, by thoſe who brought it from India. I believe it may prey on ſmall ſerpents, lizards, and other ſmall reptiles. Another bird was brought with this, ſuppoſed to be the male of this ſpecies, which died ſoon after it was landed Mr. Raymond's ſervant told me that it was ſomething larger, and the creſt longer, the head black, but that in other reſpects the two birds agreed.

I am, SIR,

Your moſt humble ſervant,

College of Phyſicians,
January, 1771.

Geo. Edwards.

VII. *An*

VI. *An Extract from the Register of the Parish of* Holy-Cross *in* Salop, *being a Second * Decade of Years from* Michelmas, 1760, *to* Michaelmas, 1770, *carefully digested in the following Table, by the* Rev. William Gorsuch, *Minister of that Parish.*

Read January 24, 1771.

		1761.	1762.	1763.	1764.	1765.	1766.	1767.	1768.	1769.	1770.	Total.	
Baptized,	Males.	17	18	20	1[illegible]	19	23	22	17	22	18	194	382.
	Females.	14	20	22	21	19	16	30	9	20	17	88	
Buried.	Males.	11	11	16	14	19	33	11	19	12	15	161	365.
	Females.	14	13	20	13	19	54	18	20	14	19	204	

Increase 17.

m. Males. f. Females.

		1761 m.	f.	1762 m.	f.	1763 m.	f.	1764 m.	f.	1765 m.	f.	1766 m.	f.	1767 m.	f.	1768 m.	f.	1769 m.	f.	1770 m.	f.	Total
Under a month		3	1	2	0	0	3	3	0	0	2	1	5	1	1	0	2	—		1	0	25
From a month to a year		2	1	0	2	3	3	3	2	2	0	6	5	2	2	5	5	1	0	3	1	48
From 1 to	2	1	1	1	0	3	3	1	0	—		3	3	0	1	3	2	—		0	2	24
2	5	1	0	1	0	1	2	1	1	0	2	0	11	2	3	0	2	3	0	1	2	39
5	10	—		0	1	—		1	1	2	0	2	5	0	1	1	1	2	3	1	2	23
10	15	—		—		—		—		1	1	1	0	—		1	0	1	0	—		5
15	20	0	1	—		1	0	1	0	0	1	2	2	—		—		0	1	1	1	11
20	25	—		—		—		0	2	—		0	2	—		—		0	1	—		5
25	30	0	1	1	0	—		—		—		0	1	—		1	1	—		—		5
30	35	—		—		—		—		0	1	0	2	0	1	1	0	—		—		5
35	40	1	0	1	0	1	1	1	0	1	1	2	1	0	2	1	0	0	1	—		14
40	45	1	1	1	0	1	0	1	1	1	1	1	1	1	0	—		2	0	0	3	16
45	50	1	0	1	2	—		—		—		0	2	1	0	1	0	1	0	1	1	11
50	55	—		0	3	0	1	—		2	1	1	0	0	1	2	1	—		0	2	12
55	60	0	2	1	0	1	1	1	0	0	1	3	2	—		0	1	1	1	—		15
60	65	0	2	—		1	2	1	1	5	1	0	3	—		0	1	0	1	2	0	20
65	70	1	0	1	1	1	0	0	1	2	3	1	2	2	1	—		—		0	[illegible]	18
70	75	0	2	0	2	1	1	0	2	1	0	1	3	1	0	0	2	0	1	2	1	20
75	80	—		1	0	1	2	—		1	1	0	1	—		1	0	0	2	2	1	13
80	85	0	1	0	1	1	0	—		1	2	3	3	1	4	2	0	1	2	1	0	23
85	90	0	1	—		—		0	1	—		—		—		0	1	0	1	—		4
90	95	—		0	1	0	1	0	1	0	1	—		—		0	1	—		—		5.
	99	—		—		—		—		—		—		0	1	—		—		—		1
	101	—		—		—		—		—		—		—		—		—		0	1	1

* *In Vol.* LII. *Part* i. *Art.* 25. *see the First Decade.*

There

There remain alive,

Under ten years of age,	Males 126, Females 122	248.	

From 70 to 75	Males 12, Females 21	33	From 80 to 85	Males 3, Females 6	9
From 75 to 80	Males 8, Females 3	11	From 85 to 90	Males 3, Females 5	8

Diſtempers and Caſualties.

Accidents	5	Convulſions	31	Palſy	3
Ague	1	Dropſy	20	Small-pox	46
Apoplexy	5	Drowned	7	Teeth	5
Aſthma	3	Evil	4	Untimely	7
Cancer	2	Fever	35	Worms	4
Childbed	4	Jaundice	4		
Chincough	6	Impoſthume	2	N.B. The remainder died of a natural decay, without any diſtemper.	
Conſumption	101	Meazles	15		

Houſes or Families in 1765, 249—in 1770, 240.
Ditto, paying window-tax, in 1765, 70—in 1770, 65.
Void houſes, none.

Number of perſons in 1765,	1096
Ditto, in 1770,	1046
	Acres.
In arable and paſture land	1400
Gardens, yards, and houſes	300
	1700

There is no waſte land.

In the year 1767, nine houſes were pulled down, to open a way for building a new ſtone bridge over the river Severn, by which forty-four perſons were removed; ſix continued in the pariſh, and thirty-eight went out of the pariſh.

VII. *A Letter from Mr.* Stephen de Vifme *to* Mathew Maty, *M. D. Sec. R. S. containing an acount of the manner, in which the* Chinefe *beat their rooms.*

S I R,

Read Jan. 31, 1771.

THE great pleafure I have in obliging and rendering any fervice to your Royal and illuftrious Society, made me requeft the Rèv. P. Gramont, miffionary, (a man of great family and fenfe, whom I was acquainted with at Canton before he was ordered to Pekin, by the Emperor) to make enquiries, and collect any curiofity ufeful to philofophy, mechanicks, and natural hiftory, that might be ufeful to mankind, and agreeable to the curious. He has been fo polite to tranfmit me the model of a Chinefe furnace, ufed to warm the apartments; together with a mufter of different coals, lime, &c. for the Royal Society, which I fend to my brother to be tranfmitted to you; and I fhall be happy that it comes fafe to your hands. Father Loreyro, miffionary and phyfician to the King of Cochin China (a gentleman we are greatly obliged to for his humanity, in cloathing, feeding, and getting a paffage to fome poor fhipwrecked feamen of the Earl Temple); is at work upon drawing a correct

 draught

draught of that coaſt and Cambodia; and I hope, when finiſhed, to obtain one for the Society.

I embrace this opportunity* of alſo making you an offer of my ſervices, and ſubſcribing myſelf with the greateſt eſteem and regard,

Sir,

Your moſt obedient

humble ſervant,

Canton,
Oct. 8, 1770.

Step. de Viſme.

* Unfortunately this gentleman died at Canton ſoon after the date of this letter, which deprives the Royal Society, and the public, of the very curious and uſeful informations they might have expected from him.

VIII. An

VIII. *An Account of the* Kang, *or* Chinese *Stoves, by Father* Gramont, *translated from the* French.

Read Jan. 31, 1770.

THE greatest of all masters is want. It is a spur to genius, gives wings to industry, and points out such resources as neither learning nor curiosity would ever have contrived. This it is which has taught the Chinese to make use of sea coal to warm their houses, and to procure to themselves the benefit of its heat without being annoyed by its offensive smoak. This discovery of the Chinese might perhaps be of use in the great city of London, and those parts of England, where this fuel is burnt in rooms. The warm concern the Royal Society has always shewn for whatever affects the lives or welfare of the community, induces us to hope for a favourable acceptance of a model of the Chinese Kang, which we apprehend may be conducive to those beneficent purposes; we therefore have added such explanations as will give an insight into the theory of it, that it may be made known, and improved upon.

May the illustrious and celebrated Royal Society consider this trifle as a token of our profound respect, and accept it as a small acknowledgement of our gratitude for the favours bestowed upon us, wretched and afflicted as we are! As we have the honour to write to gentlemen eminent for their learning, we

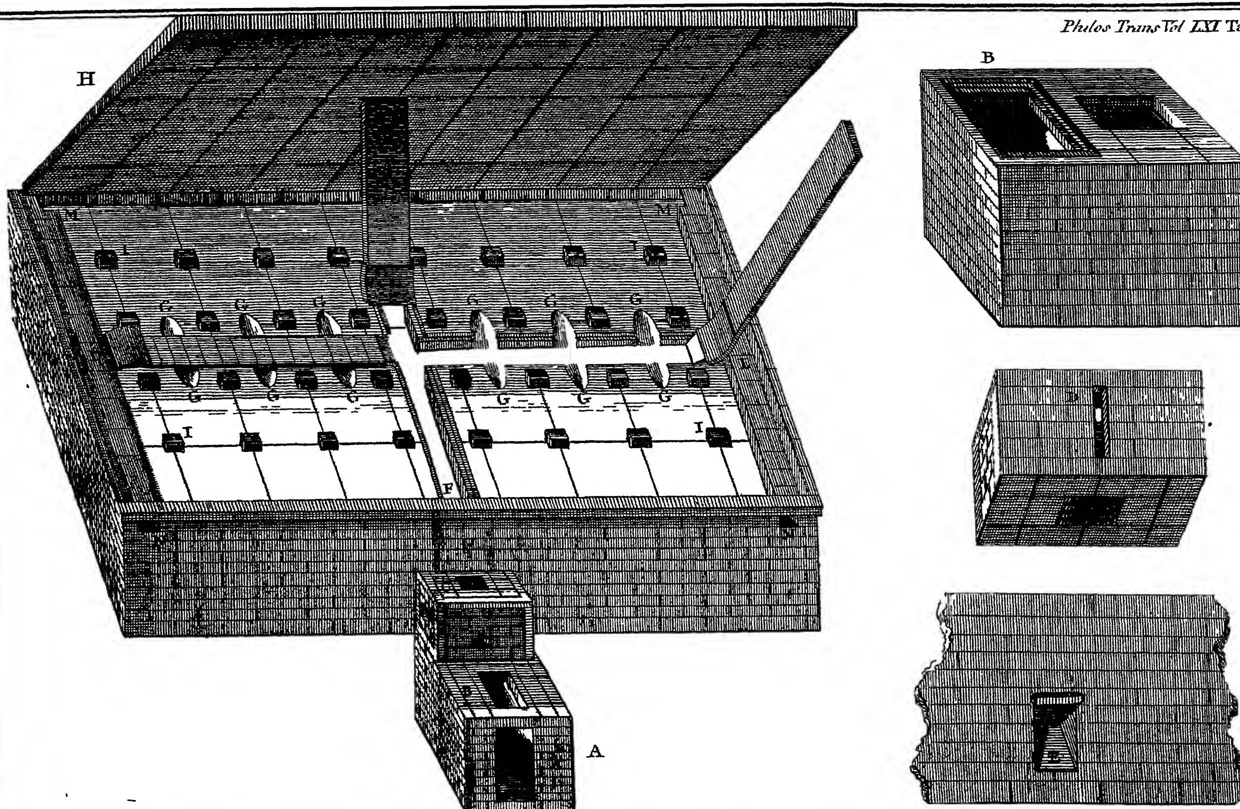
we ſhall only relate and deſcribe what is moſt eſſential.

1. A Kang is a kind of ſtove, that is heated by means of a furnace, which caſts all its heat into it. Many kinds of ſtoves, ovens, and furnaces, have indeed been contrived beyond ſea, which are ſomewhat like this; but the Chineſe ſeemed to have found means to unite all their conveniences and uſes in the Kang. They are of various ſorts, the *Kang* with a pavement, or *Ti-Kang*; the *Kang* for ſitting people, or *Koa-Kang*; and the chimney *Kang*, or *Tong-Kang*. As they are all made upon the ſame principle, we ſhall confine ourſelves to the deſcription of the *Kao-Kang*, from which the model (Tab. iii.) is taken.

The parts of a Kang are, 1. a furnace; 2. a pipe for the heat; 3. a brick ſtove; 4. two funnels for the ſmoke.

The furnace is proportioned to the ſize of the ſtove it is intended to heat. A is the aſh hole. B the cellar. C the furnace. D the ſlit, or mouth, that conveys the flame and heat into the ſtove. E The pipe or conductor for the heat. F begins at the mouth of the furnace, and forms a channel which falls in a right angle upon a ſecond, that goes quite through under the middle of the floor; and this laſt pipe has vent holes, G, here and there. The ſtove is a pavement made of bricks, H, which being ſupported at the four corners by little ſolid piles, I, leaves a hollow ſpace between them and the under pavement, where the heat remains pent up, and warms the floor. The ſmoke funnels are at both ends of the ſtove L, with a little opening M upon

2 the



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the ſtove, and another N outward, which carries off the ſmoke.

Nothing can be more ſimple than the effect reſulting from the aſſemblage of all theſe parts. The heat of the furnace, impelled by the outward air, and attracted by the rarefied air of the ſtove, ruſhes through the ſlit, aſcends into the tube, ſpreads through the ſtove by the vent holes, heats the bricks, and from them the whole room. The ſmoke, which has a free paſſage, is carried off by the funnels.

2. Admitting this deſcription, which explains the model; let us next conſider what is requiſite for the conſtruction of a good Kang. The furnace may be placed either in the room itſelf, or in the next room, or without doors. The poor, who are glad to make the moſt of the firing that warms the *Kao-Kang*, on which they ſit by day, and ſleep by night, place the furnace in the ſame room; the middling ſort put it in an adjoining room; the rich and great have it on the outſide, and moſt commonly behind the north wall. The furnace muſt be much below the level of the ſtove, that the heat and flame may aſcend with the greater impetuoſity into the conductor, and not drive up the aſhes. The furnace is in the form of a cone, ſomewhat arched, that the activity of the heat and flame may be all impelled into the ſtove, and not fly off when the aperture at the top is left open. Note, that the two little moveable ſlips are planks, that take up occaſionally, when people want to go down into the cellar and empty out the aſhes. The opening in the furnace is narrow, and the lower end of the conductor muſt go quick up into the

ſtoves

ſtove. The conductor is to be walled in very cloſe on all ſides with bricks, and well cemented with mortar made of quick lime. That which the Chineſe uſe is made with one part of white lime to two of black. The black lime, of which we ſend a ſample, is found at the entrance of the coal pits, and ſeems to us to be no other than coals diſſolved by rain waters. We can atteſt that this ſubſtance mixed with white lime makes excellent mortar, nearly reſembling cement. It is proof againſt rain and ſun, and is uſed here to cover and ſhelter whatever is expoſed to the weather. We ſhould rejoice if this hint could prove uſeful to the Britiſh nation. If their country affords black lime, they are poſſeſſed of a great treaſure.

The ground or flooring of the ſtove may be of beaten clay, or, what is infinitely better, bricks placed edgewiſe, or large paving tiles.

The funnel for the ſmoke, or rather the two funnels, muſt be made with great care. Some make them terminate in little chimneys, that carry off the ſmoke above the roof. In the model, they open into the room, as the city poor have them; but in the country, and in gentlemen's houſes, they are on the outſide.

It is of conſequence that the little piles which ſupport the great ſquare bricks of the floor be very ſolid, and the bricks very thick and perfectly ſquare. The Chineſe bind them with a ſort of cement made of white and black lime, tempered with *Tong Yeou*, which is a kind of varniſh. We are apt to think walnut or linſeed oil boiled would do as well.

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As ſoon as the Kang is compleated, fire is kindled in the furnace, to dry it quick and even. Great diligence muſt be uſed in examining it, in order to ſtop up all the little holes through which the ſmoke might eſcape. The wealthy, to make their Kang neater, and to moderate its heat, oil the bricks of the floor, and light the fire, to make the oil penetrate deeper, and to dry them the faſter. This oil is again the *Tong Yeou*, and may be ſupplied with walnut oil.

3. The *Ti Kang*, or paved Kang, is made like the *Kao Kang* juſt deſcribed; the only difference is, 1°, The pipe for the heat goes on riſing from the mouth of the furnace to the further end of the room. 2°, It does not communicate with a ſecond pipe, as in the model. 3°, The vent holes that convey the heat into the ſtove are all made narrow next the furnace, and go widening towards the ſtove. 4°, The funnels for the ſmoke always terminate without doors, or end in the little chimneys. 5°, In the Emperor's palace and thoſe of princes, the ſtove is covered with two rows of bricks, to confine the ſmoke, and to moderate the heat.

Note, That the bricks in the royal apartments are two feet ſquare, and four inches thick. They coſt near a hundred crowns apiece; and are ſo beautiful, good and ſolid, that you can have no conception of any ſuch thing beyond the ſeas. They are grey; but this is owing to the Chineſe manner of baking their bricks and tiles, which comes nearer to that of the antients than ours. Theſe bricks when coloured and glazed appear as fine as marble. The

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Tong-Kang, or the *Kang* built in the wall, differ from the *Ti-Kang* only by its perpendicular pofition; the theory is the fame.

4. The Kang is heated by lighting a fire in the furnace. The fmoke and even the flame rufhes violently into the pipe, and is carried off by the vent holes all through the ftove, where, being pent up, it heats the bricks of the pavement in the fpace of five or fix hours: when a Kang is thoroughly heated, very little fire is required to keep it warm, though here the thermometer is almoft all the winter at 9, 10, and even 12 or 13 degrees below the freezing point (in Reaumur's thermometer); and although all the rooms are on the ground floor, and have nothing but windows, and thofe paper windows, all over the front, which is commonly to the fouth, the warmth of the Kang is fufficient to keep up their temperature at 7 or 8 degrees above froft, with very little fire conftantly kept up. It feldom rifes to more than 4 or 5 degrees in the Emperor's apartments, owing to the double row of bricks, but the warmth is very gentle and very penetrating.

As a Kang is heated by a furnace, any kind of fuel will do, *viz.* wood, charcoal, fea coal, furze, &c. The Chinefe make the moft of every thing. In the palace they burn nothing but wood, or a kind of coal which neither fmoaks nor fmells, and burns like tinder. The generality of people burn fea coal: the poor in the country make ufe of furze, ftraw, cow dung, &c.

A great faving may accrue from the following obfervation; the Chinefe, to fave coals, pound them to the

the ſize of coarſe gravel, and mix them with one third, or even an equal quantity, of good yellow clay. This mixture being well kneaden, they make it up into bricks, which ſtrike a greater heat than wood, and come incomparably cheaper. The ſea coal thus tempered is far leſs offenſive; and beſides, the Chineſe, in order to draw off the noiſom vapours of the air, conſtantly heated by the coal fire, always keep bowls of water in the rooms, and renew them now and then. The gold fiſhes that are kept in theſe bowls are both an ornament and amuſement. In the palace, the Emperor's apartments are decorated with flower pots, and little orange trees, &c. The Chineſe philoſophers pretend that this is the beſt way to ſweeten the air, and abſorb the fiery particles diſperſed in it. They likewiſe leave two panes open night and day at the top of each window, to renew the air, which they think is too much rarefied by the heat. Theſe particulars may appear too trifling to be laid before the Royal Society; but, as they relate to the preſervation of their fellow citizens, we hope the worthy members will make allowances in favour of the motive.

5. The Kang is attended with many advantages and conveniencies. 1°, The rich and great are not expoſed to the troubleſome attendance on a fire in the chimney, and enjoy all its benefits. 2°, The poor uſe all ſorts of fuel without any other expence than what the kitchen requires, and have the comfort of ſitting warm by day, and lying warm by night. The fire in the furnace ſerves to dreſs victuals, and to heat the ſtove. The poor go further ſtill: they encloſe within the brick work of the Kang a veſſel, either

 of

of copper tinned, or of iron, which ſupplies them with hot water for their tea. This water evaporates in the night, moiſtens the air of the room, and abſorbs the noxious particles of the ſea coal. We cannot forbear dwelling upon theſe little œconomical obſervations, as our aim is public utility. The Chineſe are wont to ſay, The Emperor can build a palace, and cannot make a ſhrub; one word from his mouth makes a nobleman of a mere citizen, but all his wiſhes and prayers cannot prolong the lives of his favourites one ſingle moment.

It is not our part to point out what uſe might be made of the Chineſe Kang beyond the ſeas; but we apprehend that the *Ti-Kang* might be a profitable improvement for hoſpitals, manufactories, &c. and a pleaſing one for the rich. The *Tong-Kang* properly managed would do very well in upper rooms, and would afford warmth for the bed-chamber, and fire for the dreſſing-room. The *Kao-Kang* ſeems leſs adapted to the cuſtoms and manners of Europe, but induſtry might find ſome uſe for it in the country. Should the Kang be rejected on account of its novelty, ſome hints might ſtill be taken from its conſtruction for the uſe of ſeveral kinds of handicraft.

The Chineſe ſea coal may give ſome inſight into the formation, qualities, uſes, and nature of this ſingural foſſil; but this would require a ſeparate paper. All we ſhall here obſerve is, that, as far as we can judge from the ſamples we have ſeen, it ſeems for the moſt part to be a ſtone diſſolved by the waters, and impregnated with ſulphur. Its hurtful qualities proceed from a mixture of antimony, copper, iron,

&c.

&c. The beſt coal, and that which burns fierceſt, is gloſſy, hard, and brittle. The Chineſe are very fond of that ſort that flies, and ſnaps in the fire, to burn in their forges, becauſe it contains a great deal of ſalt-petre. When the flame is blue, it is very fierce, but it is too dangerous, as the ſulphur is too predominant.

Peking, 22 Oct. 1769.

P. S. If we have expreſſed ourſelves improperly, which would not be very ſurprizing, conſidering how little we are verſed in theſe matters, and how little time we can ſpare for Europe, we are ready to retract whatever may be thought amiſs, and to give what further informations may at any time be deſired. Whoever has ſo loved the Chineſe for Chriſt's ſake as to come and ſeek them in this far country, has not diveſted himſelf of his attachment to Europe, and will ever be ſolicitous for the welfare of thoſe he has left behind, and endeavour to promote it, both by their prayers, and imparting whatever may conduce to alleviate the miſeries of this ſhort life.

In what a ſtriking light do we here ſee the vanity of the world, the intoxication of philoſophy, and the wretchedneſs of thoſe who know nothing of Jeſus Chriſt! Learning, vice, and idolatry, go hand in hand in the ſanctuary of policy; which knows nothing but the Creator of the world, whom the Chineſe worſhip on their knees, and diſhonour in their lives.

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As there is room left in the box that contains the model, we have put in ſome little ſpecimens of ſea coal.

N° A. 1, 2, 3, different ſorts of ſea coal, or rather ſtones diſſolved, and turned to coals.

N° B. 1, 2, ſea coal, ſuch as is burnt here. N°. 2 is the beſt. N° 3. is the ſame coal turned to black lime. This you may be convinced of, by diſſolving it in water, and mixing it with white lime.

N° C. 1, 2, 3, 4, ſeveral degrees of bad coal, which produces a dangerous ſmoke that occaſions fainting fits. N° 4. is the worſt, and is laid by for the uſe of forges, whenever it is found.

N° D. is a kind of Clinker, extracted from the aſhes of ſea coal. That which produces the greateſt quantity of it is reckoned the beſt.

If the Society ſhould be deſirous of further informations concerning the ſea coal, we muſt beg to be favoured with particular queſtions; but let it be remembered, that we are not within reach of ſuch helps as chemiſtry would afford, nor can elucidate the matter by experiments.

IX. *Account of a remarkable Thunder Storm: In a Letter from the Rev.* Anthony Williams, *Rector of* St. Keverne, *in* Cornwal, *to the Rev.* William Borlaſe, *D.D. F. R. S.*

DEAR SIR,

Keverne, Aug. 27, 1770.

Read Feb. 7, 1771.

I HAVE received yours, which, I muſt confeſs, I ought to have anſwered much ſooner.

For ſeveral days before the thunder ſtorm which fell on St. Keverne ſpire and church, on Sunday the 18th day of February laſt, the wind was very hard at North and North Weſt, accompanied with violent ſhowers of hail, which had done ſome damage to the roof of the church, and many houſes in the church-town. On the Sunday morning above-mentioned, the wind being at North-weſt, from five o'clock during almoſt the whole day the wind was exceſſive hard; and about ſix, I ſaw ſome few faint flaſhes of lightning, which, as the day came on, if it continued, became imperceptible. The weather being ſo bad, prevented a great number of people from coming to church, which in all human probability was a happy circumſtance; for, about a quarter

quarter after a eleven o'clock, while I was in the latter end of the Litany ſervice, we had a very fierce flaſh of lightning, followed at the diſtance of about four or five ſeconds by the loudeſt thunder I remember ever to have heard; but which did no damage, nor ſeemed in the leaſt to diſturb any of the congregation, though at the ſame time the roof of the church was rifling, and the hail made a noiſe terrible to be heard. In half a minute after this, as near as I can poſſibly gueſs, the whole congregation, except five or ſix perſons, were at once ſtruck out of their ſenſes. I myſelf received the ſhock ſo ſuddenly as not to remember I either heard the thunder or ſaw the lightning: the firſt thing that I can recollect with any degree of certainty is, that I found myſelf in the vicarage ſeat, which is very near the deſk, without either gown or ſurplice, bearing in my arms as I then thought a dead ſiſter, and God knows it was a miracle that ſhe was not ſo; I perceived a very ſtrong ſulphureous ſmell, almoſt ſuffocating, and a great heat. At this time the confuſion among the congregation was inconceivable, ſome running out of the church for ſafety, and returning into it again (for the ſtones from the roof were falling on our heads, both in and out of the church); ſome on their knees, imploring the divine aſſiſtance, giving themſelves up to certain deſtruction; and a great many, in different places of the church, lying quite motionleſs, whom I thought then to be quite dead.

In the afternoon, my thoughts being a little compoſed (I believe for full two hours I could not be ſaid to be rightly in my ſenſes), I walked to the church, to ſee what damage was done; and ſuch a ſcene

ſcene preſented, as is horrible to think of, much more to ſee. The church-yard was almoſt full of ruins; the ſpire, which was about forty-eight feet high from the battlements of the tower, was carried off half way down, and the remaining part cracked in four places very irregularly down to the bottom. The north ſide of the tower from the battlements to the arch of the bell chamber window was quite out, except the corner ſtones, which remained firm and unremoved; the lead on the top of the tower was greatly damaged, melted in ſeveral places, and as it were rolled together. The arch of the belfry door, which was very ſtrongly built with a remarkable hard iron ſtone, laid in lead, was alſo greatly damaged; ſome of the ſtones were cracked croſs-ways, and juſt removed out of their places, others were quite hove out, and the lead between the joints not only melted, but looſened ſo as that you might pick it out with your fingers. The traces of the lightning were here diſcovered along the ſurface of the earth; the ſtones were thrown from the ſpire on the tops of many houſes in the Church Town, but did no great hurt; in a gentleman's houſe, one ſtone weighing fourteen pounds fell through the roof into the chamber, but did no further hurt than to make a hole in the roof and plaiſtering. It is to be obſerved, that the ſtones from the ſpire were ſcattered in all directions, as well againſt the wind as with it, ſome of which, but not very large, were found but a little ſhort of a quarter of a mile. The ſpire from the top ſix feet downwards was ſolid, through which paſſed an iron ſpill to fix the weather-cock on. Did not the lightning firſt ſtrike on this ſpill, and was conducted
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through the ſolid part of the ſpire, and, having not iron to conduct it any further, burſt in the hollow part of the ſpire, and threw the ſtones about in all directions? It is remarkable that the ſpill was found in the bell-chamber, and the weather-cock in the battlements; and that the bells were not in the leaſt damaged, though a deal board, that lay acroſs the beams to which the bells were hung, was ſplit long ways in two pieces. The inſide of the church ſtill preſented a much more horrible ſpectacle; the roof of the church was almoſt all gone, and ſome of the timber work in the north iſle ſhattered to pieces; every ſeat in the church had rubbiſh in it, ſome more ſome leſs, and ſtones of large ſize, ſome of 150 pounds weight and upwards, ſcattered here and there amidſt the congregation, which damaged the ſeats, &c. but did no hurt to the people, though they ſat in thoſe very ſeats where the ſtones fell. The lightning entered at the three ends of the church at Weſt, made its way through the body of the church, and went out through the three ends of the church at Eaſt; the holes where it came in and where it went out are not large, neither are the walls much damaged. The belfry window was ſhattered to pieces, not one whole pane I believe to be found in it; many other windows alſo ſuffered greatly, the glaſs and munnions being much ſhattered. The lightning entered alſo through two places in the roof, one near the ſinging loft, and ſtruck upon the top of a pillar juſt by it; the traces of it are to be ſeen from the top of the pillar almoſt to the bottom: there were then ſitting by this pillar two young men, one in the ſinging loft, and other under him in the church, who were

were both lightly scorched; he in the loft from head to foot, and the other in the face only: but it is remarkable that his hat, which hung on a nail just above him, was cut in two pieces. In the other place, the lightning entered just over the desk and pulpit, and fell in like manner on a pillar that stands in the vicarage seat; but here it was a great deal more violent, and, as the object of its fury was my sister, I hope you will excuse my being very particular. Upon this pillar rested a large oak soil, the bottom of which was burst into six pieces, and one of the pieces, being a very large one, was thrown from its place to the distance of about 20 feet, and appeared to be burnt, the other pieces did not fall. From thence the lightning came down the pillar with great force, tore the seat into many pieces, knocked down my sister, and made its way through the bottom of the seat into the earth. She had pattens on, and the wooden part of one of them was broke into three pieces; the holes, through which the ribbon is put to tie them together, were quite burnt out, and the ribbon found in the seat without the least damage, or so much as the knot loosened; her shoe was burnt, and rent from the toe to the buckle; but the buckle, which was of silver, remained unhurt; her stocking was burnt and rent in the foot, just in the same manner as her shoe, and scorched along to the garter, and two little holes were burnt through in the leg of it: her apron, petticoats, &c. were burnt through and through, and she had several slight burns on several parts of her body, besides two bruises on her head and breast, caused by the rubbish that fell into the seat. As she was carrying out of church, she

greatly complained of a deadneſs in her legs, which, as ſhe could not move them at all, I ſuppoſed were broke; however, they were not broke, only a little burnt, and turned as black as ink; which, by timely care, not only came to their natural colour by Tueſday noon, but could ſupport her alſo to come down ſtairs; and, excepting a hurry of ſpirits, grew quite well that week.

Not more than ten perſons out of the whole congregation were hurt, and none of them to any great degree; one young fellow, who was more frightened than hurt, remained ill a long time, but I believe he is now quite well; the lightning touched his watch in his pocket, the marks of which may be ſeen on the cryſtal and ſilver part of it to this day. Nobody remembers to have heard any more thunder, or ſeen any more lightning after this, though the weather continued very ſtormy all that day; ſo that this thunder ſtorm, from beginning to end, could laſt but a very ſhort time. The damage we ſuffer by it (which is now repairing) will amount to about 450 l.

Thus, Sir, I have given you a particular account of this dreadful accident, by which a great number of people, had it not been for the favourable, I may ſay, miraculous interpoſition of Providence, muſt inevitably have periſhed. It muſt really excite our wonder to conſider that not only not one life was loſt, but that no perſon was hurt to ſuch a degree as to confine him for more than two or three days.

I remember to have ſeen an obſervation of yours: "How deplorable would be the conſequences of ſuch "blaſts of lightning, if they happened where are "large

" large congregations in time of divine ſervice!" Here you ſee, Sir, they have happened under the very circumſtances in which you then thought they muſt prove fatal. But Providence has let us know, in this remarkable caſe, that, let the danger be ever ſo great, and ſeemingly to us unavoidable, yet he is willing, as well as able, to ſave us.

I am, dear Sir,

Your moſt obedient,

humble ſervant,

Anth. Williams.

X. *Explication of an inedited Coin, with two Legends, in different Languages, on the Reverse. In a Letter to* Mathew Maty, *M. D. Sec. R. S. from the Rev.* John Swinton, *B. D. F. R. S. Custos Archivorum of the University of* Oxford, *Member of the Academy* degli Apatisti *at* Florence, *and of the* Etruscan *Academy of* Cortona *in* Tuscany.

Good Sir,

Read Feb. 7, 1771.

THE coin I shall here attempt to explain on one side (See Tab. III. n. 1.) presents to our view the head of Jupiter, and on the other the prow of a ship, which indicates the place wherein it was struck to have been a maritime town. Above the prow of the ship, we see two characters, that are either Punic (1) or Phoenician. I say, either Punic or Phoenician, because it may not perhaps be so easy to determine whether that town was occupied by the

(1) From the present state of the Kabyles we may infer, that the ancient Africans, or Indigenæ, their progenitors, must have been a very rude uncivilized people, at the first arrival of the Carthaginians amongst them. It is therefore utterly improbable, that they ever used any alphabetical characters, before the Phoenician letters were introduced into their country by the Carthaginians; or that any other characters, peculiar to themselves, and different from the Punic, ever afterwards prevailed amongst them. I cannot therefore but think, that those learned men who suppose the reality of such characters are egregiously mistaken, as they can have nothing to advance in support of such an opinion. Shaw, *Travels, &c.* p. 288, 289, Oxford, 1738. Peller. *Suppl. quatr. & dern.* p. 55. A Paris, 1767.

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Carthaginians, or the Phœnicians, and the Romans, when the piece firſt appeared. Beſides the two above-mentioned characters, there is a monogram, formed of the three Latin letters V, A, B, very indifferently preſerved, in the exergue, with which the Punic or Phœnician elements perfectly correſpond. For the ſecond of thoſe elements is manifeſtly the moſt common Punic or Phœnician form of *Beth*, and I have many years ſince proved the firſt (2) to be a form of the Phœnician and Samaritan *Vau*; and (3) obſerved, that though it ſometimes anſwers to V conſonant, it is likewiſe not ſeldom taken for *Beth*, or B. Nor is this to be wondered at, as thoſe two letters ſo nearly in power approach one another. The middle element of the monogram, A, has nothing equivalent to it in the Punic or Phœnician inſcription; that vowel, in conformity to the genius of the oriental orthography, between the two conſonants, being there ſuppreſſed. But the two Punic or Phœnician characters, and the Latin monogram, clearly enough demonſtrate the name of the town where the piece was ſtruck. The monogram ſeems to be preceded by a ſort of date in the exergue, which reſembles the characters ⌊CXI; but, as theſe characters are ill preſerved and indiſtinct, I believe the powers of them will not be ſo eaſily aſcertained.

From what has been here laid down, the learned will eaſily admit the medal in queſtion to have been ſtruck at Vabar, a maritime city of Mauritania Cæſarienſis, after that place had been ceded to the Romans, and was inhabited by them, and either the Carthaginians or the Phœnicians. Vabars i mention-

(2) *De Num. quibuſd. Sam. et Phœn. &c. Diſſert.* p. 73, 74. Oxon. 1750. (3) Ibid. p. 74.

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ed by (4) Ptolemy, but in his days seems to have been a place of no considerable note. It, however, probably made a greater figure, when inhabited either by the Carthaginians, or the Phœnicians, and the Romans; for that it was occupied by two at least of those nations, when the medal before me first appeared, the legends on the reverse, though somewhat imperfect, render sufficiently clear. That the Carthaginians were possessed of this city in ancient times, is consonant to the faith of history; since they were masters of all that part of Africa extending from the pillars of Hercules, or streights of Gibraltar, to the greater Syrtis, for a considerable period of time, as we learn from (5) Polybius. And that the Phœnicians were masters of it in early times, is equally probable. For that they occupied the sea-coast of Mauritania, from at least the generation immediately preceding Homer to the time it fell into the hands of the Romans, we are informed by Strabo (6). It cannot therefore be easily determined, as already observed, whether the piece in question was struck by the Phœnicians or the Carthaginians. It must, however, be attributed to the town of Vabar, when inhabited by either the Carthaginians or the Phœnicians, not improbably the latter, and the Romans; the two legends on the reverse, as well as the perfect agreement between them, rendering this incontestably clear.

That the piece I am considering was either of a Punic or an Africo-Phœnician origin, may be deemed probable from hence, that it exhibits a Latin legend

(4) Ptol. *Geogr.* Lib. IV. c. ii.
(5) Polyb. Megalopolit. *Historiar.* Lib. iii. p. 266, 267. Amstelodami, 1670.
(6) Strab. *Geogr.* Lib. iii. p. 150, 151. Lutetiæ Parisiorum, 1620.

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on the reverſe, as do ſeveral other Punic or Africo-Phœnician coins. This appears from ſome of the medals of the elder Juba, one of Achola, and another of Leptis, now in my ſmall collection; to omit other ſimilar inſtances, that might, with great facility, be produced: whereas, unleſs I am greatly deceived, none of the Aſiatico-Phœnician coins have ever yet preſented to our view any Latin characters. This is an additional proof in ſupport of what has been here advanced; and ſeems farther to evince, that my medal muſt be aſſigned to the town of Vabar, and was ſtruck there, when that place was occupied by either the Carthaginians or the African Phœnicians, and the Romans; though the time of that operation cannot, with any tolerable preciſion, be aſcertained.

I ſhall only beg leave to add, that though Vabar was a place of no great note in the days of Ptolemy, it ſeems to have been a town of ſome conſideration in the earlier times, as (7) Dr. Shaw ſaw ſome ancient ruins on the ſpot where it formerly ſtood; that a coin of this ancient city has never yet, I believe, been communicated to the learned world; that the medal before me, which at preſent has a place in my ſmall cabinet, is one of thoſe very few Punic or Phœnician coins that are adorned with a Latin legend, and conſequently merits the particular attention both of the curious and the learned; and that I am, with the higheſt regard,

S I R, Your much obliged

and moſt obedient humble ſervant,

Chriſt-Church, Oxon.
Sept. 28, 1770.

John Swinton.

(7) Shaw, ubi ſup. p. 89. Oxford, 1738.

XI. *Remarks upon Two* Etruſcan *Weights, or Coins, never before publiſhed. In a Letter to* Mathew Maty, *M. D. Sec. R. S. from the Rev.* John Swinton, *B. D. F. R. S. Cuſtos Archivorum of the Univerſity of* Oxford, *Member of the Academy* degli Apatiſti *at* Florence, *and of the* Etruſcan *Academy of* Cortona *in* Tuſcany.

Good Sir,

I.

Read Feb. 7, 1771. THE firſt piece to be conſidered here is an Etruſcan as, (See Tab. III. n. 2.) or weight, exhibiting on one ſide the head of Janus, covered with a cap; and on the reverſe a club, attended by the mark of the As, and the legend I4OA⊣Ǝ4, in Etruſcan characters. Between the two faces of Janus, the head of a buſolo, or wild ox, preſents itſelf to our view, as does alſo a ſort of concha marina, or ſea-ſhell, ſomewhat reſembling one on a didrachm of Tarentum, in my ſmall cabinet, and ſeveral other ancient coins, contiguous to the cap; both of which have, not a little, ſuffered from the injuries of time. The letters on the reverſe are more

more rude and barbarous than thoſe of any ſimilar Etruſcan coins hitherto publiſhed, which is an inconteſtable proof of the exceeding high antiquity of this piece. The forms of ſeveral of them are likewiſe ſomewhat different from thoſe of the correſpondent elements on all the other ſimilar Etruſcan weights, hitherto communicated to the learned world. The concha marina, and perhaps the bufolo's head, is a ſingularity that will announce the weight before me an inedited coin. The piece weighs preciſely five ounces, and twelve grains; and is, in all reſpects, except what relates to the concha and bufolo's head, tolerably well preſerved.

The firſt riches of mankind were their flocks and their herds, and particularly their (1) oxen. Hence the firſt money in Italy, from pecus, was (2) called pecunia, and the moſt ancient braſs coins had the figure of an ox (3) impreſſed upon them. Hence alſo the Greeks, in the days of Homer (4), eſtimated the value of their properties according to the number of oxen they were equivalent to, as we learn from that celebrated poet. For he informs us, that Glaucus's golden armour was worth an hundred oxen, whereas that of Diomedes, for which it was

(1) Eraſm. Frölich. *Notit. Elementar. Numiſm. Antiquor. &c.* p. 2. Viennæ, Pragæ, & Tergeſti, 1758.

(2) Plin. *Nat. Hiſt.* Lib. xviii. p. 98. l. 6, 7. & Lib. xxxiii. p. 610. l. 6, 7. Ed. Hard. Pariſiis, 1723. Fröl. ubi ſup. et alib. *Una lettera del* Annib. degli Abati Olivieri *al Sig. Abate Barthelemy, &c.* p. 28, 29. In Peſaro, 1757. Ezech. Spanhem. *De Uſ. et Præſtant. Numiſmat. Antiquor.* Diſſert. prim. p. 23. Londini, 1706.

(3) Iidem ibid.

(4) Hom. Il. z. 235, 236, 237. Vid. etiam Euſtath. in loc.

 exchanged,

exchanged, did not exceed the value of nine of thofe animals. The figure of the ox on the moft ancient money feems to have been foon converted in Etruria into the fymbol of the head of that beaft connected with the head of Janus, who is (5) faid to have firft introduced the ufe of money into Italy. The head of the bufolo, or wild ox, may, as I conceive, have appeared on fome of the moft ancient coins of Tufcany, and particularly the piece I am at prefent confidering, becaufe the bufolo was formerly, and is ftill, a native of that country. When I refided there, above thirty years fince, the woods between Leghorn and Pifa abounded with them. They were then likewife faid to have been very numerous in other parts of Tufcany, and La Romagna; and feveral of them, at different times, both tamed and wild, I myfelf have there feen. The reafon here mentioned feems to extend to other remains of antiquity of the Etrufcans befides their coins, on which the head of the bufolo appears, as the (6) authors here referred to have rendered fufficiently clear.

From what has been obferved, as well as from the thicknefs, high relief, and extreme rudenefs of the workmanfhip, or rather in conjunction with thefe, we may conclude, that our As is either coeval with fome

(5) Cytherius Poet. apud Athen. *Deipnofoph.* Lib. xv.

(6) Anton. Francifc. Gor. *Muf. Etrufc.* Tab. CXXIII. Hamilton's *Collect. of Etrufc. Greek, and Rom. Antiqu.* Vol. II. pl. 63. I have a fine Etrufcan Vas Potorium, (See Tab. III. n. 3.) ending in a bufolo's head; which, as I apprehend, formerly belonged to Cardinal Gualtieri: as alfo another, terminating in (See Tab. III. n. 4.) the head of a gray-hound, fimilar to one publifhed by Mr. Hamilton, which had likewife a place affigned it in the Cardinal's collection of Etrufcan antiquities. I bought both of them of Sig. Barazzi, at Rome, in 1733. Hamilton's *Collect. of Etrufc. Greek, and Rom. Antiquit.* Vol. I. pl. 49.

of

of the earlieſt pieces, or weights, ever uſed in Italy, or but little poſterior to them. Father Gori (7) ſeems to be of the ſame ſentiments with me, in this particular; and neither Sig. (8) Olivieri, nor any other writer, has invalidated, or diſproved, what has been advanced on this head, by that celebrated author.

That the weight here conſidered is to be aſſigned to a maritime town, the concha marina, or ſea-ſhell, irrefragably proves. I ſhould therefore, with the very learned Sig. Olivieri, rather attribute it to Volterra, than to Velitræ (9), at preſent called Velletri, as Father Gori (10) ſeems to have done. For Velitræ was a town of Latium, and much leſs conſiderable than the city of Volterra; which (11) was the moſt ancient city of Etruria, the ſeat of a lucumo, and one of the moſt conſiderable places in Tuſcany. It was alſo a maritime city (12),

(7) Anton. Franciſc. Gor. *Muſ. Etruſc.* Vol. II. p. 419. et alib. Florentiæ, 1737.

(8) Sig. Oliver. *Una Letera, &c.* In Peſaro, 1757.

(9) Annib. degli Abati Olivieri, in *Eſame della Controverſia Letteraria, ſopra il Muſeo Etruſco, ſtampato negli Opuſcoli ſcientifici*, Tom. XXI. et ubi ſup. p. 43. The old Etruſcan word VELATRI, FELATRI, or FELATERI, ſeems to have been tolerably well preſerved in the name of Monte Veltrajo, or Feltraio, a mountain in the territory of Volterra, and about two miles from that city. This, as I apprehend, may be conſidered as an additional argument in ſupport of Sig. Olivieri's and Monſignore Mario Guarnacci's opinion. *Notizie Iſtorich. della citta di Volterra, oper. del Sig.* Lorenz. Aul. Cecin. *dal Caval.* Flamin. Dal Borgo, p. 44, 49. In Piſa, 1758. Monſig. Mar. Guarnacci, in *Origin. Italich.* In Lucca, 1767.

(10) Anton. Franciſc. Gor. *Muſ. Etruſc.* Vol. II. p. 427.

(11) Chriſt. p... Cellar. *Geogr. Ant.* Lib. II. c. ix. ſect. 2. p. 573, 574. Lipſiæ, 1731. Vid. etiam Tho. Dempſt. *De Etrur. Regal.* et Anton. Franciſc. Gor. *Muſ. Etruſc.* paſſ.

(12) Strab. Lib. V. p. 223. Lutetiæ Pariſiorum, 1620.

as we learn from Strabo, being ſeated not far from, the Vada Volaterrana, near the place were the river Cæcina threw itſelf into the Tyrrhenian ſea. I would therefore read the legend, on the reverſe of this coin, FELATHERI, FELATERI, or FELATERRI; the fifth letter being (13) ſometimes endued with the power of *Theta*, and ſometimes with that of *Tau*; and a duplication of conſonants, in writing, having been unknown to the moſt ancient Etruſcans. That the vowel E, between the fifth and ſixth elements of the Tuſcan legend, on the reverſe hereon, ſhould be ſuppreſſed, or omitted, will not be any matter of ſurprize to thoſe who are apprized, that ſuch a ſuppreſſion, or omiſſion, ſo conſonant to the genius of the Hebrew and Phœnician orthography, from which that of the moſt (14) ancient Etruſcans could not have greatly differed, in old Tuſcan words, does not ſeldom (15) occur. Of this MENLE, HERCLE, MELACRE, PHVLNICE, MENREA, which were read MENELE, or MENELAE, HERCVLE, MELEACRE, PHVLVNICE, MENEREA, or MENERFA (16), are convincing proofs; to omit many other ſimilar inſtances, that might, with great facility, be produced. But this is ſo ſettled a point, that it

(13) Anton. Franciſc. Gor. *Muſ. Etruſc.* Vol. II. p. 408, 409.

(14) Swint. *De Linguâ Etrur. Regal. Vernac. Diſſertat.* Oxon. 1738.

(15) Phil. Bonarot. Tho. Dempſt. et Anton. Franciſc. Gor. ubi ſup. paſſ. Vid. etiam Joan. Bapt. Paſſer. Piſaurenſ. *Helleniſm. Etruſcor. in Symbol. Litterar.* &c. Vol. II. p. 35—73. Florentiæ, 1748, & Carlo Antonioli in *Antic. Gem. Etruſc. ſpiegat. & illuſtrat.* &c. p. 70—78. In Piſa, 1757.

(16) Iidem ibid.

4 will

will not be conteſted in any part of the learned world.

II.

The ſecond piece, or weight, of which I propoſe to give an account in this paper, is a ſtips uncialis, (See TAB. III. n. 5.) as appears both from the weight and ſize of it, of the earlieſt date. I received it, as a preſent, from my worthy friend James Gilpin, Eſq; late recorder of the city of Oxford, with ſeveral other ancient braſs coins. On one ſide it has preſerved the head, or rather a full face, of the * ſun; the workmanſhip of which is more rude and barbarous than that of any other ſimilar piece that ever fell under my view; and done pefectly in the moſt ancient Etruſcan taſte. The reverſe had originally on it the prow of a ſhip, which has been ſo totally effaced by the injuries of time, that only a very few exceeding faint traces of it are now to be ſeen. The relief on the face-ſide is very high, as was undoubtedly at firſt that on the other; but the reverſe being in a manner quite ſmoothed, nothing there remains but the veſtiges of the prow of a ſhip, that are barely viſible. However, juſt over the prow, we may diſcover clearly enough the legend , in Etruſcan characters, though but very indifferently preſerved. That

* We meet with a full face of the ſun pretty much reſembling this on a denarius of the Plautian family, but done in a much more elegant taſte; which demonſtrates it to be vaſtly inferior, in point of antiquity, to the piece I am now offering my thoughts upon. Sig. Havercamp. *Theſaur.* Morel. Tom. II. p. 329. Amſtelædami, 1734.

word

word is apparently equivalent to ROMA, and consequently the piece itself must be deemed an uncia, or stips uncialis, of Rome, though the globule, or uncial mark, has not escaped the ravages of time.

That the piece in question is an uncia of Rome, appears not only from the legend on the reverse, as just observed, but likewise from another uncia of Rome, with the full face of the sun upon it, as here, though done in the more modern Roman taste, now in my small collection. That uncia is likewise, I doubt not, in several (17) other collections; being, as I apprehend, a pretty common coin. The same conclusion is likewise deducible from another Roman uncia, with the word ROMA, just above (See TAB. III. n. 6.) the prow of the ship, on the reverse, in the very same situation as the Etruscan legend on the weight before me, in my little cabinet. We may therefore safely enough pronounce the coin here described a stips uncialis of Rome, of a very remote antiquity, with the Etruscan name of that capital of the world on the reverse.

The Etruscan letters were, undoubtedly, the first alphabetic characters of Italy. Nay, they prevailed at Rome, and in every part of Italy, till after the regifuge. This I have fully proved in a Latin (18) dissertation,

(17) Scipionis Maffeii *Origin. Etrusc. & Latin.* p. 61. Tab. II. Ord. II. n. ii. Lipsiæ, 1731. Annib. degli Abati Olivieri in *Indice Delle Antichiss. Monete di Bronzo Romane & Italich.* ubi sup. p. 53. In Pesaro, 1757. See Haverc. in *Rom.* Tab. III. n. 4.

(18) *De Priscis Romanorum Literis Dissertat.* Oxon. 1746. Many curious particulars are deducible from the point here insisted upon. To omit others that occur, from hence it plainly follows, that those inscriptions on the Eugubian tables consisting of Latin letters, or the more modern characters of Italy, are

dissertation, printed at Oxford, in 1746. The piece at present engaging my attention is an additional, or rather an apodictical, proof of the truth of what was there advanced. It demonstrates the Etruscan letters to have been used at Rome, in very early times; and consequently evinces, in the strongest manner, the principal point insisted upon in that dissertation.

The time when the medal I have been considering first appeared, for want of proper chronological characters, and sufficient light from history, cannot, with any precision, be ascertained. But, from a perusal of the small performance (19) above-mentioned, and what has been offered here, we shall, I believe, be induced to conclude, that it is at least coeval with the regifuge, which happened in the year of Rome 245; or rather, as I should apprehend, that it may be a considerable number of years anterior to that event.

The two brass coins above described being extremely curious, especially the second of them, an Etruscan coin of Rome having never been heard of before; and many curious points being deducible

more recent than the regifuge. Nay, in the dissertation here referred to, they have been demonstrated inferior, in point of antiquity, to the Duilian inscription; and consequently Father Gori must be egregiously mistaken, when he makes all the inscriptions on those tables some generations older than the Trojan war. See the *Universal History*, Vol. XVI. p. 48. Lond. 1748.

It may not be improper to remark here, that the Etruscans had not the letter O in their alphabet, but constantly made use of V for that element. Hence it came to pass, that the Etruscan name of Rome was not Roma, but Ruma, as it appears on my very ancient coin. *Philosoph. Transact.* Vol. LVIII. p. 256.

(19) *De Prisc. Romanor. Lit. Dissertat.* p. 6, 7, 8, 9, 10. Oxon. 1746.

from that coin, which I have not time at present even to touch upon; I was willing to flatter myself, that the short account of them, in this paper, would not be unacceptable to the Royal Society. I have therefore taken the liberty to transmit it to you, in order to its being laid before that very learned and most illustrious body; and am, with great truth,

Good Sir,

Your much obliged,

and most obedient, humble servant,

Christ-Church, Oxon.
Sept. 29, 1770.

John Swinton.

XII. *Interpre-*

XII. *Interpretation of Two* Punic *Inſcriptions, on the Reverſes of two* Siculo-Punic *Coins, publiſhed by the Prince* di Torremuzza, *and never hitherto explained. In a Letter to* M. Maty, *M. D. Sec. R. S. from the Rev.* John Swinton, *B. D. F. R. S. Cuſtos Archivorum of the Univerſity of* Oxford, *Member of the Academy* degli Apatiſti *at* Florence, *and of the* Etruſcan *Academy of* Cortona *in* Tuſcany.

DEAR SIR,

Read April 11, 1771.

THE two Punic legends, of which I am now to attempt an interpretation, have been publiſhed, together with five others, by the Prince (1) di Torremuzza, in his volume of ancient inſcriptions, printed at Palermo, in 1769. As the coins, on which they have been preſerved, ſeem extremely curious, and are unnoticed by any other author; the Royal Society will indulge me the liberty of tranſmitting them my ſentiments of thoſe very valuable remains of antiquity, in this paper, drawn up in the ſhorteſt and moſt conciſe manner poſſible.

(1) *Sicil. et objacent. inſular. veter. inſcript. nov. collect. &c.* claſſ. XX. p. 292, 293. Panormi, 1769.

The

I.

The first of these minute inscriptions, (See TAB. III. n. 7.) which is the first of those published (2) by the Prince di Torremuzza, in the place here referred to, adorns a fine Punic tetradrachm, as it should seem, well enough preserved; which on one side presents to our view the head of a woman, and three fishes; but, on the reverse, the head of an horse, behind which stands a palm tree, attended by an inscription, in the exergue, formed of seven Punic letters. The workmanship, as well as the types, is probably similar to that of the silver medals of Menæ, by me described and explained, in (3) one of my former papers.

The first of the letters, of which this inscription is composed, will be allowed an *Ain* of the usual Punic form. This may be collected from the (4) coins of Menæ, just mentioned, as well as others, that might easily be produced. The second seems to be *Nun*. But it has been inaccurately taken, and is in reality *Mem*. This is likewise clearly evinced by the (5) legends on the reverses of other similar Siculo-Punic coins. The third is undoubtedly the Punic

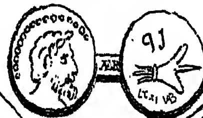
(2) Ibid, p. 292.

(3) *Philosoph. Transact.* Vol. LIV. Tab. xi. n. 1. p. 99, 404.

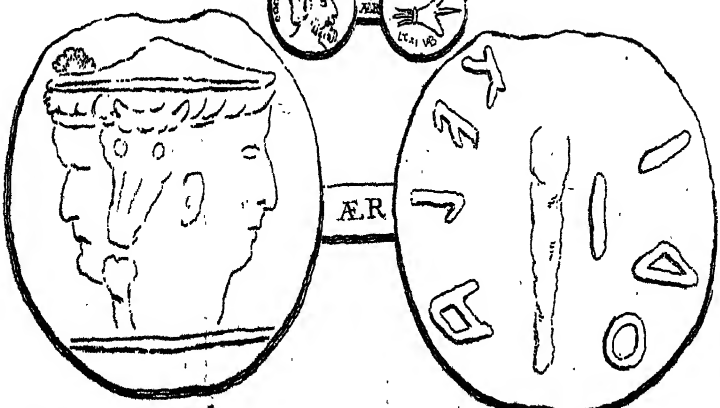
(4) *Philosoph. Transact.* ubi sup.

(5) *Philosoph. Transact.* ubi sup. D. Bernard. Aldret. *Var. Antiguedad. de Espan. &c.* p. 177—180. D. Vincen. Juan de Lastanos. *Mus. de las Medal. desconocid. Español.* Tab. 45. En Huesca, 1645. Peller. *Recueil de Medaill.* &c. Tom. Trois. p. 22. pl. 88. n. 5. A Paris, 1763. *Memoir. de Litterat. de l'Academ. des Inscript. & Bell. Lettr. &c.* Tom. Trentiem. p. 417. pl. ii. n. 8, 9, 10, 12. A Paris, 1764.

TAB. III. n. 1.

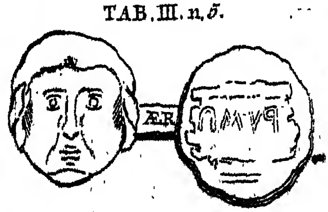


TAB. III. n. 2.

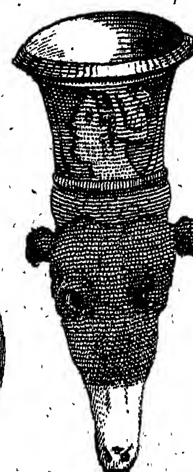


TAB. III. n. 3.

TAB. III. n. 5.



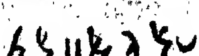
TAB. III. n. 4.



TAB. III. n. 6.

TAB. III. n. 7.

TAB. III. n. 8.



Basire sc.

or Pœnician *Samech* (6), nearly as it appears in the famous Maltese inſcription, and not unlike the form of that element exhibited by one of thoſe found at Citium, now in the Bodleian Library, Oxon. The fourth and ſixth are ſo (7) like the Punic and Phœnician *Ghimel* that they cannot well paſs for any other element. The fifth is manifeſtly *Hheth* (8), though it ſeems to have ſomewhat ſuffered from the injuries of time. The ſeventh (9) greatly reſembles the moſt common figure of *Thau*, and therefore we cannot be much miſtaken if we take it for that letter. The powers of the Punic characters forming the inſcription ſtanding thus, we may, I conceive, read the whole AM SEGHEGT, or SEGEGTH, which is but a ſmall variation from the word SEGESTE, or SEGESTA, the Greek and Latin name (10) of a conſiderable maritime city of Sicily, not far from Eryx, where money was coined, after the Greeks (11) had poſſeſſed themſelves of the place. The medal therefore adorned with this minute Punic inſcription may, without any impropriety, be ſuppoſed to have been emitted from the mint at Segeſta, as the Punic words, AM SEGHEGT, or SEGEGTH, POPVLVS SEGESTANVS, appear upon it, when the Cartha-

(6) *Philoſoph. Tranſact.* ubi ſup. Vol. LIV. Tab. xxii. p. 394. *Memoir. de Litterat. &c.* ubi ſup.

(7) *Philoſoph. Tranſact.* ubi ſup. Tab. xxiv. p. 408, 409.

(8) *Philoſoph. Tranſact.* ubi ſup. p. 404. & Tab. xxiv.

(9) *Philoſoph. Tranſact.* Vol. LIV. Tab. xi. p. 99. & Tab. xxiv. p. 404.

(10) Chriſt. Cellar. Notit. Orb. Antiqu. Lib. II. c. xii. p. 397, 398.

(11) Fil. Parut. *La Sicil. Num.* in Num. di Segeſt.

ginians

ginians were maſters of that city, and occupied all the adjacent territory appertaining to it.

That the Carthaginians were actually poſſeſſed, for a certain period, of that part of Sicily where Eryx and Segeſta had their ſituation, does not only appear (12) from antient hiſtory, but likewiſe from a long Punic inſcription, found at the former of thoſe places. This inſcription has been (13) publiſhed by the Prince di Torremuzza, who extracted it from Sig. Antonio Cordici's manuſcript hiſtory of Eryx, with a copy of which he was ſupplied by Sig. Dominico Schiavo, in the very valuable and learned work mentioned in the beginning of this paper.

That ſuch rough and uncouth words as SEGHEGT, or SEGEGTH, with vowels ſcarce ſufficient to form, or facilitate, the pronunciation, were not unknown to the Carthaginians, we may infer from the words SBAQTNI, ENGKARA, ESCQVAR, FIEGKV, GHERQ, IGHASESC, and many others that occur in the remains of the ancient Punic tongue, which (14) at preſent exiſt in the vernacular language of the Malteſe.

From what has been here advanced, it is inconteſtably clear, that SEGESTE, or SEGESTA, is a word of a Punic origin; which, indeed, has been obſerved by the famous Bochart. That learned au-

(12) Polyb. Diod. Sic. Liv. Oroſ. &c. *Univ. Hiſt.* Vol. vi. p. 829. et alib. Lond. 1742.

(13) *Sicil. et objacent. inſular veter. inſcript. nov. collect. &c.* claſſ. xx. p. 296, 297. Panormi, 1769.

(14) *Canonico* Gio-Pietro Franceſco Agius de Soldanis, in *Dizionar. Punico-Malteſ.* paſſ. In Roma, 1750.

thor has (15) sufficiently exploded the fabulous account of Acesta, the pretended founder of Segesta, given us by some of the ancient writers; though, for want of the assistance of the Punic coin before me, he could not hit upon the true name the city now in view, at least when the medal I am considering first appeared, went under amongst the Carthaginians.

As no chronological characters occur on the piece considered here, the time when it was struck cannot, with any precision, be ascertained. That operation must, however, have preceded the conclusion of the first Punic war; since the Carthaginians, by the treaty of peace which terminated that war, ceded the (16) whole of their possessions in the island of Sicily to the Romans. Nay, the medal I am endeavouring to throw some light upon was probably prior, perhaps many years, to the surrender of Segesta (17) to the Romans, in the beginning of the first Punic war, when the inhabitants of Segesta put the African garrison there to the sword, about 258 years before the birth of CHRIST; the Carthaginians seeming never to have been possessed of this ancient city, after that tragical event.

(15) Sam. Bochart. *Chan.* lib. I. c. 27. p. 563, 564. Francofurti ad Mœnum, 1681.

(16) Polyb. Liv. Oros. Zonar. &c. *Univ. Hist.* Vol. vi. Lond. 1742.

(17) Polyb. Diod. Sic. Liv. Oros. &c. *Univ. Hist.* Vol. vi. p. 829. Lond. 1742.

II.

The ſecond of the two abovementioned (See TAB. III. n. 8.) inſcriptions, which is the ſixth of thoſe publiſhed, in the place above refered to, by the Prince di Torremuzza, is compoſed of ſeven letters. Of theſe the firſt and ſecond are undoubtedly *Ain* and *Mem*, as we may certainly infer from a ſimilar inſcription, on the reverſes of other Punic coins, that have been (18) heretofore explained. The third muſt be *He*, as it ſo (19) much reſembles a form of the Greek *Epſilon*; the antient figures of the fifth element in the Greek, Phœnician, and Samaritan alphabets having (20) been originally the ſame. The ſenſe of the inſcription ſeems likewiſe abſolutely to require this. The fourth letter is apparently *Mem* (21), as will be allowed by every one in the leaſt acquainted with the ancient Siculo-Punic, and Siculo-Phœnician, characters. The fifth is *Hheth*, or *Heth*, as we may collect from (22) other medals, ſimilar to that on

(18) *Philoſoph. Tranſact. Memoir. de Litterat. de l'Acad. des Inſcript. & Bell. Lett. &c.* D. Bern. Aldret. D. Vincen. Juan de Laſtanos. Peller. ubi ſup.

(19) Sig. Haverc. *de Lit. Græc. Diſſert.* p. 248, 249. Vid. *Syllog. Scriptor. qui de ling. Græc. rect. pronuntiat. &c.* Lugduni Batavorum, 1736.

(20) Vid. Hadr. Reland. D. Bern. de Montfauc. Don Luis Joſeph Velazquez, Chiſh. alieſque Scriptor. quam plurim.

(21) *Philoſoph. Tranſact. Memoir. de Litterat. de l'Acad. des Inſcript. & Bell. Lettr. &c.* Aldret. Laſtanoſ. Peller. &c. ubi ſup.

(22) *Philoſoph. Tranſact.* Vol. LIV. Tab. xxiv. p. 408, 409. & Tab. xi. n. 1. p. 99, 404.

which

which this legend has been preserved. Part of this element, however, has been defaced by the injuries of time; which to demonstration appears (23), not only from coins already published, but likewise from others preserved in the cabinets of the great and the curious, to which easy access may be had. The sixth must be *Nun*, as we may conclude from all the abovementioned (24) coins. The draught of it, however, given us by the Prince di Torremuzza, seems somewhat to resemble one of the forms of *Mem*, and therefore it was probably not taken with the utmost accuracy; the Prince, perhaps, not being so thoroughly conversant with the various figures of the Siculo-Punic, and Siculo-Phœnician, letters, and learned men but little acquainted with those figures pretty frequently mistaking one similar letter for another. This character likewise is apparently different from the form of *Mem*, in the same inscription, and seems not a little to resemble the usual form of *Nun*; as will appear to every one, examining it with proper attention. The seventh is *Thau*, as will be admitted, I believe, by every one versed in this branch (25) of literature. The inscription, therefore, of which I am at present attempting an interpretation, is formed of the two words עם המחנות, AM HAMMAHANOTH, HAMMEHNOTH, or HAMMENOTH, POPVLVS MENENIVS, or MENA-

(23) *Philosoph. Transact.* Vol. LIV. p. 99, 404, & Tab. xi. n. 1. p. 99. *Memoir. de Litterat.* &c. ubi sup. Pl. II. n. 7, 8, 9, 10, 12. p. 417. Aldret. Lastanos. Peller. &c. ubi sup.

(24) *Philos. Trans. Mem. de Litterat.* &c. Aldret. Lastanos. Peller. ibid.

(25) Barthel. Peller. &c.

RVM POPVLVS, as we may find rendered incontestable by other (26) similar coins.

In Hebrew the prefix ה is not seldom added to the (27) beginning of the proper names of provinces, cities, and towns. So וירגלו את־העי, AND VIEWED AI. Jehos. vii. 2. מן השטים עד הגלגל, FROM SHITTIM TO GILGAL. Mich. vi. 5. וכל־ערי הגלעד, AND ALL THE CITIES OF GILEAD. Jehos. xiii. 25. To which I could add many more instances of the same mode of expression, that might, with equal facility, be produced. As the Punic and Phœnician languages therefore (28) agreed in most points with the Hebrew, we may naturally suppose the Phœnician, or Carthaginian, inhabitants of Menæ to have impressed the words עם המחנת, AM HAMMENOTH, upon their most ancient coins.

The medal, which has conveyed down to us this inscription, through such a series of ages, is of the tetradrachmal form, and of a very considerable antiquity. It has a place assigned it in the (29) very valuable cabinet of the Prince di Torremuzza, though he has not favoured us with a draught of it. On one side it exhibits the head of a woman, goddess, or tutelary deity of the place where it was struck, with three fishes sporting round it; and on

(26) *Phil. Transf. Mem. de Litterat. &c.* Aldret. Lastanos. Peller. ubi sup.

(27) Johan. Buxtorf. *Thesaur. Grammat. Ling. Sanct. Hebr.* p. 385. Basileæ, 1651.

(28) Sam. Bochart. *Chan.* lib. II. c. 1. *Philosoph. Transact.* Vol. LIII. p. 292. & Vol. LIV. p. 134.

(29) *Sicil. et adjacent. insular. veter. inscript. nov. collect. &c.* class. xx. p. 293. Panormi, 1769.

the

the reverſe a horſe's head, under which appears the inſcription, that is one of the principal objects of my attention, in this paper. It will be almoſt needleſs to remark, that the horſe's head is one of the moſt uſual ſymbols on the reverſes of the antient Carthaginian coins.

With regard to the third character here, taken by me for *He*, I would beg leave to remark, that it is the creſcent, or lunated form of the Greek *Epſilon*; which was a figure of that element of a pretty high antiquity, though not the (30) firſt uſed by the Greeks. That it was as early in Sicily as Julius Cæſar's days, has been proved from (31) the coins of Entella, coeval with that emperor. And that it was known in Italy many years, perhaps ſeveral generations, before (32) the finiſhing ſtroke was given to the Roman republic, is clearly evinced by a moſt curious minute Greek ſepulchral inſcription, publiſhed by P. D. Gianfranceſco Baldini, of which a particular account will be found in the very valuable work referred to here. Nay, in Greece it ſeems to have a long time preceded this monument (33), as may be inferred from two minute inſcriptions preſerved on two antient Greek ſtatues of Speuſippus and Xenocrates, mentioned by a very learned modern author. It may therefore, with ſufficient

(30) Sig. Haverc. *De Lit. Græc. Diſſert.* p. 248, 249. in *Sylloge Scriptor. qui de ling. Græc. ver. et rect. pronun.* &c. Lugdun. Batavorum, 1736.

(31) Fil. Parut. *La Sicil. num.* Tab. cxiv. n. 2, 3. Sig. Hav. ubi ſup.

(32) *Sag. di Diſſertaz. Accademich. di Corton*, Tom. II. p. 157. In Roma, 1738.

(33) Sig. Haverc. ubi ſup. p. 248.

propriety, be ſuppoſed as ancient as at leaſt the later ages of the Carthaginian empire in Sicily, if not much older. That the moſt ancient form of the Greek *Epſilon* was alſo ſometimes impreſſed upon the Punic medals of Menæ, is rendered inconteſtable by a moſt valuable tetradrachm of that city, publiſhed (34) by M. Pellerin. The firſt letter of the legend, on the reverſe of that tetradrachm, is the Punic *Ain*, not very accurately taken; and the third is undoubtedly the oldeſt Phœnician, Samaritan, and Greek figure of *He* or *Epſilon*, brought by Cadmus out of Phœnicia, and repreſenting, according (35) to Euri-

(34) Peller. *Recueil de Medaill.* &c. Tom. Troiſ. p. 22. pl. 88. n. 8. A Paris, 1763. The city of Menæ, the Μηναὶ of Ptolemy, was built by Deucetius, king of the Siculi, but ſubject to the Carthaginians, from the days of Dionyſius the elder, king of Syracuſe, to the time of Timoleon, the Corinthian, according to Diodorus Siculus; in ſome part of which interval, the piece I have been conſidering, as well as all others ſimilar to it, was probably ſtruck. From Menæ's being a town of the Siculi, and inhabited by them and the Greeks, M. Barthelemy infers, that it never was ſubject to the Carthaginians, and that therefore the piece in queſtion could not poſſibly have made its firſt appearance there. But the former of theſe aſſertions is expreſsly contradicted by Diodorus Siculus, and therefore the latter of them muſt neceſſarily fall to the ground. Of this the learned antiquary above-mentioned ſeems to have been ſufficiently aware, when he declares, that he does not give us for demonſtration what he has advanced on this head. I muſt beg leave here farther to remark, that the word מחנת cannot well he tranſlated *Caſtra* here, as the proper names of cities are generally, if not always, pointed out to us, by the legends on the reverſes of ſuch coins. Diod. Sic. lib. xi. c. 78. Vid. etiam lib. xii. xiii. xiv. See the *Univ. Hiſt.* Vol. VII. p. 535. Lond. 1747.

(35) Euripid. et Agath. Tragic. apud Athen. *Deipnoſoph.* lib. x. c. 20.

pides,

pides, and Agathon, in Athenæus, an obliquated trident. That inſcription is formed of the very ſame letters with thoſe that conſtitute the legend I am conſidering, and conſequently will admit of the ſame interpretation. Nor can this be matter of ſurprize to thoſe who conſider, not only that the firſt figure of the Greek *Epſilon* was (36) borrowed from the earlier Phœnicians, but likewiſe that the later form of that element, which was alſo ſufficiently ancient, as I have here inconteſtably proved, might likewiſe have been deduced from a later figure of the Phœnician, or Punic, *He*, in a country chiefly occupied by the Greeks (37), Phœnicians, and Carthaginians, for a very conſiderable period. And that this was really the caſe, from the legend on the reverſe of the coin of which I am now attempting an interpretation, ſeems abundantly clear. The Prince di Torremuzza has likewiſe (38) rendered the antiquity of this form of the Phœnician, or Punic, *He* inconteſtable. All which conſiderations being maturely weighed, and due attention given to the medals here deſcribed; the power of the third element of the legend, or inſcription, before me, will appear, I would flatter myſelf, to be ſufficiently aſcertained.

(36) Edm. Chiſhul. *Inſcript. Sig.* Sig. Haverc. ubi ſup.

(37) Herodot. Thucyd. Polyb. Diod. Sic. Liv. Strab. Oroſ. Zonar. &c.

(38) *Prolegom.* p. 39, 40. From the Siculo-Punic medals mentioned in this paper, as well as many others, it ſeems clearly to appear, that the prefix ה was never annexed to the word עם, AM, POPVLVS, on the Siculo-Punic coins, as M. Barthelemy has been pleaſed to aſſert, but to the proper name of the place immediately following it. This, if allowed, muſt be deciſive in favour of what I have formerly advanced, relative to the power of the character taken by that learned antiquary for *He*, but by me for *Mem*. *Philoſoph. Tranſact.* Vol. LIV. p. 397.

If

If what has been juſt advanced ſhould be admitted by the learned, they will readily allow the oldeſt forms of *He* on the antient Siculo-Punic coins, to have greatly reſembled, or rather to have been almoſt perfectly the ſame with, thoſe of that letter exhibited by the earlieſt Phœnician, Samaritan, Greek, and Etruſcan, coins. Nor can any thing be more conſonant to the faith of hiſtory than ſuch a notion. We cannot therefore ſuppoſe *He* to have reſembled any of the forms of *Mem*, or rather to have been repreſented by one of thoſe forms, as M. Barthelemy (39), without any juſt grounds for his opinion, has actually ſuppoſed, as nothing ſeems more remote from truth than ſuch a ſuppoſition. Antient hiſtory, antient coins, and the reaſon of the thing itſelf, notwithſtanding his exalted merit, and the great figure he ſo juſtly makes in the republic of letters, decide the point in queſtion moſt clearly and evidently againſt him.

Nor will it avail him to (40) aſſert, that the Greek coins of Menæ differ in ſeveral reſpects from thoſe conſidered by me in this paper; and that the (41) workmanſhip of the latter is better than that of the pieces which are the acknowledged productions of that city. For that the workmanſhip of ſeveral of the Punic and Phœnician coins is highly finiſhed and elegant, and that the taſte and genius of thoſe coins differ conſiderably from the manner of thoſe ſtruck by the Greeks and the Romans, will not admit of a doubt.

(39) Barthel. in *Memoir. de Litterat. &c. de l'Academ. des Inſcript. & Bell. Lettr. &c.* Tom. XXX. p. 409, 410, 411, 417.

(40) Barthel. *Lettre a Monſ. le Marquis Olivieri, &c.* p. 28, 29. A Paris, 1766.

(41) Id. ibid. p. 28.

The

The former have not their reverſes diverſified by ſuch a variety of ſymbols as have the latter. The Carthaginians, in particular, ſeem to have adorned their medals with very few ſymbols, or types; and thoſe ſuch as were, for the moſt part, common to all the cities and towns ſubject to their republic. As the legend therefore, on the reverſe of the medal I have been endeavouring to explain, is clear and expreſs in favour of my explication, and plainly points out to us the place where it was ſtruck; the abovementioned (42) objections, hinted at by M. l'Abbé, after what has been juſt obſerved, will fall to the ground of courſe, and not be allowed, by the beſt and moſt competent judges of the point in queſtion, to have the leaſt tendency to invalidate what has been advanced in favour of my opinion.

Several curious particulars, not hitherto touched upon, are deducible from the coin, or rather my explication of the coin, I have been conſidering. But as I have already exceeded the limits propoſed to myſelf, when I began this paper, it is time to conclude; which I ſhall beg leave to do, with aſſuring you, that I am,

Good Sir,

Your much obliged,

and moſt obedient, humble ſervant,

Chriſt-Church, Oxon.
October 2, 1770.

John Swinton.

(42) *Lettre à Monſ. le Marquis Olivieri, &c.* p. 27, 28, 29.

XIII. *Extract*

XIII. *Extract of two Letters from* M. Messier, *of the Royal Academy of Sciences, and F. R. S. to* M. de Magalhaens, *on a new Comet: Translated by Dr.* Bevis, *F. R. S.*

Read Jan. 24, and Feb. 1, 1771.

PLEASE, Sir, to inform the Royal Society, that I discovered a new Comet, the 10th of Jan. instant, 1771, about eight o'clock in the evening; it was between the head of Hydra and the Little Dog, over the parallel of Procyon. The position whereof I determined by comparing it with that star, and the star δ in Hydra. The observations are as follow:

1st Obs.	The 10th of Jan. 1771, at	10	16	45	true time.
	Right Ascens. of the Comet	121°	47	16	
	North Declination	5	21	15	
2d Obs.	Same night at	21	19	5	
	Right Ascens. of the Comet	120	24	31	
	North Declination	6	4	46	

From which observations it appears, that in $3^h\ 2'\ 20''$ of time its motion in right ascens. was $1^\circ\ 22'\ 45''$ and $43'\ 31''$ in declination: this comet was perceived by the bare eye. In the telescope its nucleus is bright, of a whitish complexion, and not very well defined, surrounded with an atmosphere several minutes wide, with a faint tail 5 or 6 degrees long. Its apparent motion among the fixt stars contrary

trary to the order of ſigns, from the equator towards the North pole.

This makes the twelfth Comet I have diſcovered and obſerved in thirteen years paſt.

— — — — —

WITHOUT what I had done the 10th of January for determining the poſition, and forming any tolerable conjecture of the direction of the motion of the comet, it would have been impoſſible for me to have found it afterwards; for from the 10th to the 16th the ſky was every night quite clouded, during which the light of the comet had extremely abated, and its motion decreaſed, inſomuch that between the 16th and 17th of January the ſky clearing, I ſought for it two hours, without finding it; but though with little hopes of ſeeing it, I ſought for it in Perſeus and Andromeda. After a world of uſeleſs pains and look-outs, at length I ſaw it again, between the horns of the Bull, of a very feeble light: and it was neceſſary to be acquainted with the heavens as well as I was, to find where it was; nor have any of our aſtronomers, as far as I can yet learn, ſucceeded in their attempts. I obſerved it January 10th, 16th, 17th and 20th, on which laſt day it was extremely cloſe to the planet Mars, leſs than a minute of time, both in right aſcenſion and declination, and its light ſo languid as to be in a manner extinguiſhed by that of Mars. Without that excellent teleſcope which you procured for M. le Preſident de Saron, I ſhould not have perceived it with any of my inſtruments. Here follow my obſervations, which may poſſibly turn out the only good ones, and which I intreat you to lay before the Royal Society.

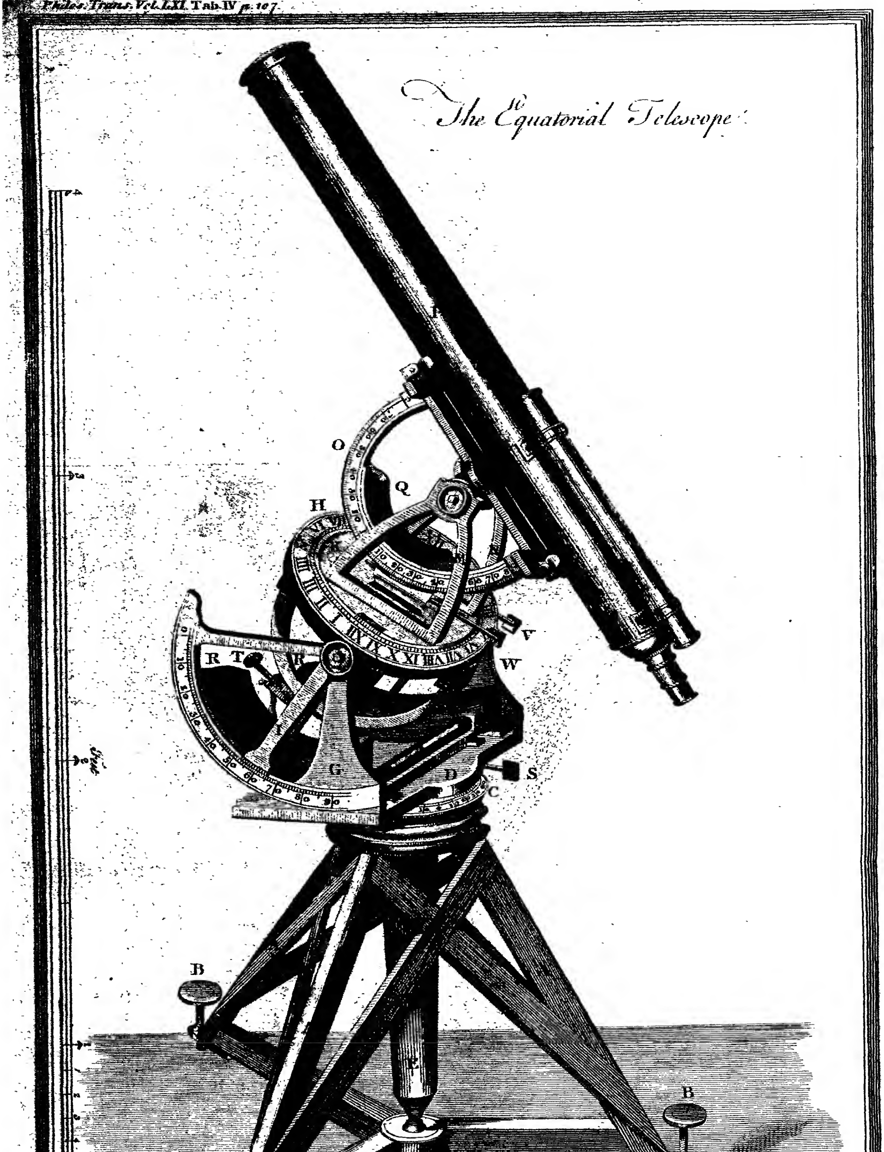
1771	True Time. h ' "	Rt. Ascension ° ' "	No. Declin. ° ' "	
Jna. 10	8 44 24	122 27 46	5 4 37	Estimate position to δ Hydræ.
	10 16 45	121 47 16	5 21 15	Determined position by a * of the 7th mag. then unknown, as also by δ Hydræ.
	10 46 31	121 35 31	5 36 51	By δ Hydræ.
	12 48 58	120 49 16	6 1 47	By the same * of Hydræ, repeated.
	13 19 5	120 24 31	6 14 46	By Procyon.
16	7 16 4	84 3 17	22 39 21	By ζ the South horn of the Bull.
	7 41 39	84 1 32	22 40 51	By the same.
17	6 27 35	80 41 58	23 45 25	By Flamsteed's 121 of Taurus and the 163
	6 40 34	80 40 28		of La Caille.
	7 2 37	80 37 13	23 46 51	By the same.
	7 21 23	80 35 28		By the same *.
20	8 18 30	72 52 2	25 55 25	By a * of the 8th mag. observed on the merid.
	8 18 30	72 52 25	25 55 28	By the planet Mars.
	8 56 49	72 47 47	25 56 47	By the above * of the 8th mag.
	8 56 49	72 48 17	25 56 46	By the planet Mars.
	9 19 24	72 47 17	25 57 3	By the above * of the 8th mag.
	9 19 24	72 47 32	25 57 4	By Mars.

Such are my observations, from whence M. Pingré has deduced the following Elements of its orbit.

	s ° ' "
Ascending ☊	3. 18 42 10
Indication of the orbit	31 25 55
Place of the perihelion	8. 28 22 44
Log. of the perihel. dist.	9,722833

Passed the perihel. the 22d of November, 1770, at 22h 5′ 48″ M.T. at the royal observatory, motion retrograde. He adds, " that this " comet resembles none of those whose elements are determined, " on comparing its motion with the places of its Perihel and ☊: it " is easy to see, that it was impossible to discover it at Paris before " the year 1771; and it may even be added, that it must frequently " have passed in the Sun's neighbourhood, imperceptible to the " Northern parts of the Earth."

XIV. *De-*



The Equatorial Telescope

E. Nairne inv. et fecit.

Ja. Basire del. et Sculp.

XIV. *Description and Use of a new constructed Equatorial Telescope or portable Observatory, made by Mr.* Edward Nairne, London.

Read Feb. 7, 1771.

THE Instrument consists of the following parts (see the annexed Plate, TAB. IV.) a mahogany triangular Stand A A A, and three adjusting screws B B B; a moveable azimuth Circle C, which is divided into degrees, and by a vernier index to every 6 minutes; above this azimuth Circle is the horizontal plate D, to the under part of which is fastened the vertical conical axis E; on the middle of the upper surface of the horizontal plate, is placed a ground glass Level F, by which the plate D is set parallel, and the pillar E perpendicular to the horizon; from this plate rise perpendicularly two quadrants G G, one of which is divided for the latitude into half degrees, and has a vernier index to 3 minutes; the equatorial plate H, with its hour circle, is supported by the two quadrants G G; its axis of motion (which is placed near the hours XII. XII.) passes through the centers of the quadrants, and carries the index I, pointing to the divided quadrant; the equatorial plate is divided into half degrees, and has a vernier index shewing every 3 minutes of right ascension or 12 seconds of time; it is figured to shew

both

both degrees and time; to prevent misapprehension, it may be right to remark that the hours XII. XII. ought properly to have been placed according to the meridian line; they are here placed otherwise, for the convenience of better seeing the meridian distance shewn by the vernier; On the upper part of the equatorial plate is the plate K; upon this plate K, are fixed the two supporters M M, which support the axis N, under which is fastened the semicircle of declination O, divided into half degrees, and has a vernier index subdividing it to 3 minutes; on the upper part of this axis, is fixed an achromatic Telescope P, which magnifies about 50 times; to the eye End of this Telescope, is applied a small reflecting speculum making an angle of 45° with the axis of the telescope, whereby objects that are in the zenith or any other altitude may be observed, without putting the body in any inconvenient position; to the under part of the axis N, is fastened a brass arm carrying the weight Q, which counterbalances the telescope, and the brass work annexed to it; whilst the weights R R counterbalance in like manner the whole of the instrument that is moveable on the equatorial axis, so that whatever position the instrument is put in, it will there remain, being perfectly balanced; the four motions of this instrument may, when required, be moved extreamly slow, by means of the indented edges of the circle and semicircles, and the screws or worms to which the handles are fixed, *viz.* that for the horizontal motion marked S, called the horizontal handle, that marked T the handle of latitude, V the equatorial handle, and W the declination handle.

To

To adjuſt the inſtrument for obſervation, the firſt thing to be done is to make the horizontal plate D level, by means of the ſpirit level, and the three adjuſting ſcrews at the bottom of the ſtand; this being done, move the equatorial plate either with or without the latitude handle, until the index on the quadrant points to the latitude of the place; and then the equatorial plate will be raiſed, to the elevation of the equator of the place, which is equal to the complement of the latitude (and which, if not known, may likewiſe be found by this inſtrument, as will appear hereafter); and thus the inſtrument is ready for obſervation. The manner of uſing this inſtrument for the following obſervations, I ſhall borrow in part from the words of the late ingenious Mr. Short, in his deſcription of his equatorial teleſcope*, which, however, differs eſſentially in conſtruction from this.

To find the Hour of the Day, and the Meridian of the Place.

Firſt, find from aſtronomical Tables, the Sun's declination for the day; and for that particular time of the day; then ſet the declination ſemicircle to the declination of the Sun, taking particular notice whether it is North, or South; and ſet the declination ſemicircle accordingly, you then turn about both the horizontal handle and equatorial handle, until you find the Sun preciſely concentrical with the field of the teleſcope; if you have a clock or watch at hand, mark that inſtant of time, and by looking upon the equatorial plate and vernier index, you will find

* Vide Phil. Tranſ. Vol. XL. p. 242.

the

the exact apparent time of the day, which, comparing with the time ſhewn by the clock or watch, ſhews how much either of them differ from apparent time; in this manner you find the hour of the day.

To find the Meridian of the Place.

[The inſtrument remaining as in the laſt obſervation.]

You firſt move the plate K until the vernier on it cuts the 12 o'clock hour, and, diſcharging the ſcrew to which the declination handle is fixed, turn the teleſcope down to the horizon, and obſerve the point which is then in the middle of the field of the teleſcope, or cut by the interſection of the croſs wires, and a ſuppoſed line drawn from the center of this field, to that point in the horizon, is your meridian line, where a mark may be ſet up in order to preſerve it; you may likewiſe preſerve this line, by the azimuth circle, which being made moveable, ſhould be turned ſo as to bring the o of the azimuth plate to agree with its vernier, when the teleſcope is pointed to the meridian; this motion in the azimuth plate will be found very convenient, ſince you may thus recover the meridian line by it, and it will ſhew the exact azimuth of any object the teleſcope is directed to, without diſturbing any other part of the inſtrument: the beſt time of the day for making this obſervation for finding your meridian, is about three hours before noon, or as much after noon; the meridian of the place may be found by this method very nearly, and, if proper allowance be made for refraction,

fraction, it may be found to great exactneſs; this line once ſettled, will ſave trouble afterwards, and is indeed the foundation of all aſtronomical obſervations.

To find a known Star or Planet at any propoſed inſtant of time, whether in the day or night.

The inſtrument remaining rectified as in the laſt obſervation; ſet the declination ſemicircle to the declination of the planet, at the propoſed inſtant, and bring the index of the equatorial plate, to point to the meridian diſtance of the ſtar or planet, at the propoſed inſtant if weſtward, or to the complement of the meridian diſtance if eaſtward of the meridian. (This diſtance is found by adding together the right aſcenſion of the Sun in time, and the apparent time of the day, and taking the difference between the ſum and the ſtar's right aſcenſion in time; when the ſtar's right aſcenſion in time is greater than the above ſum, the meridian diſtance will be Eaſt; when the ſtar's right aſcenſion is leſs than the ſum, the meridian diſtance is Weſt.) Having thus ſet the Inſtrument, look through the teleſcope, you will ſee the ſtar or planet; and if it ſhould afterwards get out of the field, you will eaſily recover it, by moving the equatorial handle only, provided the ſtar is above the horizon, becauſe the diurnal motion of a ſtar is parallel to the equator.

By this inſtrument moſt of the ſtars of the firſt and ſecond magnitude may be ſeen even at midday, and the Sun ſhining bright, as alſo Mercury, Venus, and Jupiter; Saturn and Mars are not ſo eaſy to be ſeen, in the day time, upon account of the faintneſs of

their

heir light, except when the Sun is but a few degrees above the horizon; in the ſame manner in the night time, when you can ſee a ſtar or planet, or any new phænomenon, ſuch as a comet, you may find its declination and meridian diſtance or complement thereof, by turning about the equatorial handle and declination handle, untill you ſee the ſtar, planet, or new phænomenon; and looking upon the equatorial plate, you find its meridian diſtance or complement thereto, and upon the declination ſemicircle its declination. In order to have the other uſes of this inſtrument, you muſt ſet it to the hour XII on the equatorial plate, and to o on the ſemicircle of declination, and ſet the axis E perpendicular to the horizon, and then this inſtrument becomes an Equal Altitude Inſtrument, a Tranſit Inſtrument, a Theodolite, a Quadrant, an Azimuth Inſtrument, and a Level; the manner of applying it to theſe different purpoſes is obvious.

The following is one Example of its Uſes in finding the Altitude of any Object.

Set o of the ſemicircle of declination, to agree with o of its vernier index, and faſten it there; fix likewiſe the vernier of the equatorial plate to 12 o'clock, or o degrees; then, having ſet the axis E perpendicular, by means of the level F, turn the inſtrument about horizontally upon the axis E, and vertically upon the axis of motion of the equatorial plate, until the object appears in the middle of the field; and the index I will point out upon the quadrant G,

G, the zenith diſtance of the object, the complement of which to 90° is its altitude; hence the greateſt or meridian altitude may be found, from which the latitude of the place may be deduced in the uſual manner.

XV. *Experiments to ſhew the Nature of* Aurum Moſaicum: *By Mr.* Peter Woulfe, *F.R.S.*

Read, Feb. 14, 1771.

THE Aurum moſaicum is known by the names of Aurum muſivum, Aurum muſicum, and Purpurina. We can collect but very imperfect ideas of this preparation, from the writings of antient and modern chemiſts. It is true, that the method of making it has been deſcribed by many; but no one hitherto has led us into the knowledge of its nature, by a ſufficient number of experiments. It has been much uſed formerly as a pigment, but is now almoſt laid aſide, and the Bronzes ſubſtitued in its place. It is ſometimes uſed in medicine as a vermifuge, but how improper and uncertain it is for that purpoſe, will appear by the following experiments.

The beſt preparation deſcribed hitherto for making Aurum moſaicum, is ſet down in the London Diſpenſatory, and is as follows.

Take of tin twelve ounces, of flowers of ſulphur ſeven ounces, of ſal ammoniac ſix ounces, and of purified mercury ſix ounces; melt the tin, and add the mercury to it; and when cold, powder it, and mix with it the ſal ammoniac and ſulphur. Sublime the mixture in a matraſs. The Aurum moſaicum will

will be found under the ſublimate, with ſome droſs at the bottom *.

Ætiology of the Operation.

As ſoon as the mixture grows warm, the tin acts on the ſal ammoniac, and ſets free its volatile alkali; and this, having a great affinity with ſulphur, joins with a great part of it †, riſes in the ſublimation, and is totally diſſipated. The portion of tin, which acted on the Sal ammoniac and ſet free its volatile alcali, unites with the acid of ſalt of the ſal ammoniac, and forms a ſalt of tin, which ſublimes ‡. The mercury, which was added only in order to divide the tin, unites with ſome of the ſulphur, and likewiſe ſublimes and forms a cinnabar. The tin which remains, unites with the remaining ſulphur, and forms the Aurum moſaicum, which is found in the bottom of the matraſs. Inſtead of performing this operation in a matraſs, I have uſed a glaſs retort, fixed in a black lead crucible, with ſand round it; the crucible was put into a proper furnace, and a charcoal

* The proportion formely uſed was equal parts of each, which in the quantity of tin here employed, viz. ℥ 12, produced only ℥ 13½ of Aurum moſaicum; whereas the ſame quantity of tin in the proportion of the London diſpenſatory afforded ℥ 16.

Troy weight was made uſe of in all the following experiments.

† Sulphur combined with volatile alcali forms a volatile liver of ſulphur, called by Mr. Boyle volatile tincture of ſulphur and quick lime.

‡ Filings of tin, calx of tin, or tin divided by amalgamation with mercury, diſtilled with ſal ammoniac, &c. decompoſes it, whereby its acid of ſalt unites with the tin, and its volatile alkali is ſet free.

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fire made round it, an adopter was luted to the retort, and to the adopter a quilled receiver; a long vial was fitted to the quill of the receiver, in order to hold the liquor that diſtilled.

It will be eaſy by this apparatus to perform the operation without any conſiderable loſs, provided the fire be well regulated. It is neceſſary to make a very ſlow fire at firſt, in order to condenſe the volatile fumes; for a great quantity of air is ſet free, when the ingredients begin to act on one another. The fire ſhould be rather ſlow for the firſt four or five hours, and then gradually encreaſed, until the crucible becomes moderately red hot; in which ſtate it is to be continued during the reſt of the operation, which commonly laſts about ſixteen hours from the beginning to the end.

If this operation be performed for the ſake of the Aurum moſaicum only, or for its ſublimate, it may as well be done in a matraſs or body; and in that caſe there is no great loſs of the ſublimate.

Twelve ounces of tin with ſulphur, ſal ammoniac and mercury in the proportion of the London diſpenſatory, prepared in this manner produced,

	℥	ʒ	℈
* Of volatile liver of ſulphur, liquid and dry	1	4	2
Of ſublimate found in the retort and adopter	13	2	0
Of Aurum moſaicum	16	0	0
Loſs in the operation	0	1	1
Weight of all the ingredients	℥ 31	0	0

* The volatile liver, for the moſt part, comes over liquid, and is often found in the long vial in form of moſt beautiful ramifications, which are a cryſtallization of the volatile liver.

The

This operation was often repeated, and always with ſome little variation in the products, owing to the management of the fire, which cannot be always made alike.

If this preparation be made with too great a degree of fire, the Aurum moſaicum will be partly melted, or of a dark colour; and if the fire be not continued for a ſufficient time, a portion of the cinnabar and ſalt of tin will remain with the Aurum moſaicum.

The Sublimate of Aurum moſaicum examined.

The ſublimate, which was obtained in preparing the Aurum moſaicum weighing ℥ 13 ʒ 2 was finely powdered and digeſted with diſtilled water ſharpened with ſome acid of ſalt *, and when cold was filtered; more water was added to what remained in the filter, by which means it was deprived of its ſoluble part.

† The undiſſolved part of the ſublimate dried, and then ſublimed in a retort, produced ℥ 9½ of cinnabar, which was of a dark colour, owing to an exceſs of ſulphur; there came over into the receiver a ſmall quantity of an acid liquor, and there was found in the retort ℥ ½ of Aurum moſaicum, which added to the former quantity makes ℥ 16½.

The ſoluble part of the ſublimate is compoſed of tin united to the acid of ſalt; in order to know the quantity of tin which it contains, a ſufficient quantity of fixed alcali diſſolved in water was added

* Salt of tin mixed with water becomes turbid, and a portion of the tin precipitates; therefore the acid of ſalt was added, to prevent the precipitation.

† This contains ſome running mercury; but in the ſublimation it diſappears, and forms cinnabar.

to it, by which means the tin was precipitated; this precipitate weighed ℥ 2 ʒ 7.

An ounce of tin diſſolved in the acid of ſalt *, being precipitated with a ſolution of fixed alcali in water, well waſhed and dried † weighed ℥ 1¼; ſo that a precipitate of tin contains only $\frac{4}{5}$ of tin, and therefore the ℥ 2 ʒ 7 of precipitate obtained from the ſublimate contain only ℥ 2 ʒ 2½ nearly of tin; this being deducted from ℥ 12, the quantity of tin uſed in the operation, makes ℥ 9 ʒ 5½, which is the real quantity of tin contained in the ℥ 16½ of Aurum moſaicum obtained in this proceſs; therefore ℥ 1 $\frac{7}{10}$ of Aurum moſaicum contains ℥ 1 of tin, and ℥ $\frac{7}{10}$ of ſulphur; for ℥ 9 ʒ 5½ of tin is to ℥ 16½ of Aurum moſaicum, as ℥ 1 of tin is to ℥ 1 $\frac{7}{10}$ nearly of Aurum moſaicum. This will be further illuſtrated by other experiments.

The tin, which was precipitated by adding a fixed alkali to the ſoluble part of the ſublimate, was diſtilled with iron filings and fixed alkali; but no mercury was obtained. This ſhews that none of the mercury unites with the acid of the ſal ammoniac.

There was no volatile alkaline ſmell produced by the addition of fixed alkali to the ſoluble part of the ſublimate, though there were an exceſs of it added; which proves that the ſal ammoniac was totally decompoſed.

* The vapour, which ariſes in diſſolving tin in the acid of ſalt, becomes inflammable, when the ſolution is made in large quantity, by means of heat; the like happens alſo with regard to lead.

† This precipitate, if dried with too much heat, takes fire, and burns like a dried plant that contains nitre.

The

The ſoluble part of the ſublimate of Aurum moſaicum produces cryſtals of an irregular form, which do not deliqueſce in the air like all other ſalts of tin, owing chiefly to their having a leſs portion of acid. A drop of the ſolution of this ſublimate, cryſtalliſed on a piece of glaſs, and viewed with a microſcope, has very much the appearance of the cryſtals of alum.

Aurum moſaicum, when well prepared, is of a ſhining golden colour, has no taſte, and is not ſoluble in water. It is not acted on by acids, nor by fixed or volatile alkalis diſſolved in water. If melted with an equal quantity of fixed alkaline ſalt of tartar, it forms a liver of the colour of gumbouge, which is, for the moſt part, ſoluble in water, and may be precipitated by any acid.

If Aurum moſaicum be diſtilled with iron filings, no mercury will be obtained.

It is well known, that tin deflagrates violently with nitre; therefore it will not ſeem ſurpriſing, that the Aurum moſaicum ſhould have that property in a far greater degree, it being a compoſition of tin and ſulphur *.

Sulphur, combined with metallick ſubſtances, renders them inactive, as we ſee in cinnabar, antimony, &c.; therefore Aurum moſaicum well prepared muſt be a very unfit medicine for worms.

Aurum moſaicum is often found to have a very rough taſte; but that is owing to the ſalt of tin, which has not been ſufficiently diſſipated in the ſublimation, and, in that ſtate it may effectually deſtroy

* May not this ſubſtance be uſeful in fire-works, as alſo ſulphurated iron?

worms;

worms; but it muſt be allowed to be a very uncertain medicine, and perhaps dangerous, as it may contain too ſmall or too great a quantity of the ſalt of tin.

If ſalt of tin be good for worms, it would be right to aſcertain its doſe, and give it in a proper vehicle.

Tin combined with Sulphur, by Fuſion.

Four ounces of tin melted and ſaturated with ſulphur weighed ℥ 5, and formed a black ſhining flaky brittle ſubſtance when melted. The tin need not be made quite red hot for this operation; for, when the ſulphur is mixed with it, a deflagration enſues, and the mixture grows red hot. In order to ſaturate the tin with as much ſulphur as poſſible, it muſt be added to it at two or three different times. The tin, notwithſtanding, cannot be, by this means, perfectly ſaturated with ſulphur; for after powdering and ſifting it, there remains in the ſieve a portion of the tin, which will flat under the peſtle, and not powder any more, unleſs melted and combined with more ſulphur. If this operation be done with too great a degree of fire, the increaſe of weight will not be ſo conſiderable, on account of the great fire, which diſſipates ſome of the ſulphur.

Four ounces of Aurum moſaicum melted in a covered crucible loſes ʒ 6 of its weight, and becomes a maſs ſomewhat like melted ſulphurated tin, though it be not ſo ſhining, nor ſo flaky, but rather more of a needle form. If the fuſion be repeated two or three times, ſome of its ſulphur will be each time diſſipated, and have exactly the appearance of ſulphurated tin.

Aurum mosaicum melts much more readily than sulphurated tin; and that, because it contains a greater quantity of sulphur.

Sulphurated tin, by calcination, is totally deprived of its sulphur and phlogiston. ℥ 4 of tin saturated with sulphur, and then carefully calcined weighed ℥ $4\frac{1}{2}$, so that a calx of tin prepared in this manner, weighs $\frac{1}{9}$ more than the tin it contains *.

Four ounces of Aurum mosaicum calcined in the same manner, weighed ℥ 3, ʒ 2, ℈ 1, which, being a calx of tin, of the nature of that made with sulphurated tin, contains $\frac{1}{9}$ less of tin, which $\frac{1}{9}$ being deducted, makes ℥ 2, ʒ 7, ℈ 1, gr. $4\frac{1}{2}$, the quantity of tin contained in ℥ 4 of Aurum mosaicum †. An ounce of Aurum mosaicum carefully calcined, and reduced with flux, produced only ℥ $\frac{1}{2}$ and gr. 11 of tin: we may conclude from the foregoing experiments, that ℥ 1 of Aurum mosaicum contains more than this quantity of tin; but it is well known that metallick bodies, which have been much calcined, and especially tin and zinc, always lose in their reduction.

Aurum mosaicum will be of a black colour, if too small a quantity of sulphur be used, and if the fire be too strong and too long continued †.

* All metallick substances, and even zinc, though a good deal of it dissipates in flowers, increase in weight by calcination.

† It is almost impossible to calcine Aurum mosaicum, without some loss; for it is so light and subtil, that it cannot be stirred without dissipating some of it; therefore the quantity of tin which it contains, cannot be exactly ascertained by this means.'

Receipts for making Aurum Moſaicum without Mercury.

1ſt. Take ℥ 8 of granulated tin ſifted through a fine ſieve, and mix it well with ℥ 6 of ſulphur, and ℥ 4 of ſal ammoniac; put the mixture into a matraſs or body, and calcine it for ſix or ſeven hours. The Aurum moſaicum hereby obtained is not of ſo bright a colour, as that made in the uſual manner; and that, on account of the tin not being ſufficiently divided in order to unite well with the ſulphur.

2d. Take ℥ 8 of tin reduced to a calx by calcination, and mix it well with ℥ 7 of ſulphur, and ℥ 4 of ſal ammoniac; calcine it as the former. This makes a good coloured Aurum moſaicum, though it be found here and there of an unequal colour, owing to ſome of the tin, which had been too much calcined, and thereby prevented from uniting with the ſulphur.

3d. Take ℥ 8 of tin, and ſaturate it by fuſion with ſulphur, powder and mix it well with ℥ 5 of ſulphur, and ℥ 4 of ſal ammoniac; calcine the mixture as before. This produces a good coloured Aurum moſaicum.

Receipts for preparing Aurum Moſaicum, without Mercury or Sal ammoniac.

1ſt. Take ℥ 8 of tin, ſaturate it by fuſion with ſulphur, and mix it with ℥ 4 more of ſulphur, and calcine as before, but with a leſs degree of fire. This forms rather a dark coloured Aurum moſaicum, owing to the ſulphur which melts, and in great

meaſure

meaſure ſeparates and ſwims on the ſurface of the ſulphurated tin.

2d. Take ℥ 10 of ſulphurated tin, powder and mix it well with ℥ 4 of ſulphur, and ℥ 2 of ſpirit of ſalt; calcine the mixture as the former. This forms an Aurum moſaicum of a tolerable good colour. This mixture ſoon grows warm of it ſelf after being put into the body, and produces a penetrating vinous ſmell, no ways like that which is afforded by diſſolving tin in the acid of ſalt.

In this operation, part of the tin unites with the acid of ſalt, and is at laſt diſſipated in the operation.

3d. Take ℥ 8 of tin, and ſaturate it with ſulphur, powder and mix it with ℥ 5 of ſulphur; put it into a body, and pour on it ℥ 2 of volatile liver of ſulphur obtained in making Aurum moſaicum, and calcine it as fore. This does not make ſo good a coloured Aurum moſaicum as the former, owing to the fuſion of the ſulphur, which in great meaſure ſeparates from the ſulphurated tin. Soon after the volatile liver was poured on the mixture of ſulphurated tin and ſulphur, it grew ſo hot that the body could ſcarcely be held in the hand.

4th. Take ℥ 4 of tin, ſaturate it with ſulphur, powder and mix it well with ℥ 2 of ſulphur, and ℥ 1 of tin diſſolved in the acid of ſalt and cryſtalliſed; calcine it as uſual. This produced ℥ 6½ of very good and quite taſteleſs Aurum moſaicum, ſo that ℥ 4 of tin by its union with ſulphur encreaſed in weight ℥ 2 ½.

This operation was done in a retort, to which there was luted an adopter and receiver, in order to collect

the ſalt of tin, which for the moſt part came over congealed.

5th. Take ℥ 10 of ſulphurated tin, powder and mix it well with ℥ 16 of corroſive mercury ſublimate; put it into a retort, to which an adopter and receiver is to be luted, calcine it for ſix hours, at firſt with a middling fire, and for the laſt three hours the retort muſt be red hot.

In this operation, a portion of the tin unites with the acid of the mercury ſublimate; and forms the ſmoaking liquor of Libavius, which diſtills for the moſt part in a liquid form; the mercury contained in the mercury ſublimate unites with a ſmall portion of ſulphur (about $\frac{1}{7}$ of its weight), and ſublimes in form of cinnabar in the top of the retort; the remaining tin, having a ſufficiency of ſulphur, forms the Aurum moſaicum, which is found at the bottom of the retort of a moſt beautiful ſparkling golden colour.

The reaſon for obtaining Aurum moſaicum by this operation is, that the greateſt part of the tin unites with the acid of the mercury ſublimate, and riſes in diſtillation; the remaining tin has thereby a ſufficient quantity of ſulphur to form the Aurum moſaicum.

Some of the foregoing receipts did not well ſucceed at the firſt or ſecond trial; and many other experiments, which did not anſwer, have here been omitted.

From the foregoing experiments, we may certainly conclude, that Aurum moſaicum is a combination of tin and ſulphur; it contains better than $\frac{1}{3}$ of ſulphur. It alſo appears that the only uſe of the

mercury,

mercury is to divide the tin; and that the ſal ammoniac ſerves only to prevent the fuſion of the ſulphur.

The following proportion will anſwer better than that of the London Diſpenſatory; for there will be a greater produce of Aurum moſaicum, though a leſs quantity of mercury and ſal ammoniac be uſed.

Tin ℥ 12, ſulphur ℥ 7, ſal ammoniac ℥ 3, and mercury ℥ 3.

This proportion yields ℥ 17½ of Aurum moſaicum, whereas that of the London Diſpenſatory gives only ℥ 16.

The ſoluble part of the ſublimate of Aurum moſaicum anſwers far better for dying than any ſolution of tin; a ſmall quantity of it with cochineal will dye ſilk, and eſpecially cloth, of a fine ſcarlet colour; ſilk may be dyed of a fine crimſon colour, by its means, with the addition of brazil wood, peach wood, or braziletto; but with logwood, ſilk and cloth may be made of a great variety of fine purple colours, which ſeem laſting.

The property, which this ſublimate has of making finer colours than any ſolution of tin, engaged me to make many trials, with other preparations of tin; and I found, that when tin was united to the acid of ſalt, and diſtilled or ſublimed, it would produce finer colours than any ſolution or combination of tin, unſublimed or undiſtilled.

I muſt be excuſed for the preſent, for not telling the reaſon of this; it may be diſcovered by examining well the products, which are obtained by making the liquor fumans of Libavius, in the common manner.

May not iron and copper, united to the acid of ſalt and ſublimed, anſwer better for dying, than other preparations of iron and copper?

Moſt other metallick ſubſtances may be after this manner more intimately combined with a greater portion of ſulphur than by fuſion. Biſmuth is the only one, which produced a golden colour, and that not ſo fine a one as Aurum moſaicum. Iron, copper, lead, and regulus of antimony, produce black combinations; arſenic forms a reddiſh maſs like realgar; zinc does not in this manner, nor in any other way that I know, combine with ſulphur.

An Apparatus for making Aurum Moſaicum in the cheapeſt manner.

A glaſs veſſel cannot be uſed for this operation more than once, becauſe it is neceſſary to break it, to get out the Aurum moſaicum. The following utenſil may be employed a great number of times, and ſave the expence of glaſs.

Take a black lead crucible, N°. 60; bore a round hole in its bottom about three inches diameter; and ſaw off an inch of its upper edge; if it has a lip, get a round piece of burnt clay, of an inch thick or rather more, to fit exactly into this edge; the compoſition, which is uſed for making paving-tiles, anſwers very well for this purpoſe. In order to make uſe of this apparatus, fit the round piece of burnt clay to the inner edge of the crucible, by means of ſome loam ſoftened with glue, and dry it ſlowly; then turn it upſide down, and lay it in a proper furnace on two iron bars. The mixture for the Aurum moſaicum is to be put in through the round

round hole at top, and then covered with an aludel and luted; this ſerves to collect the flowers and the ſublimate which riſes. The fire is to be made under and all round the crucible. 11 ℔. Troy of Aurum moſaicum may be made here at a time; and when the operation is over, the bottom or round piece of burnt clay will eaſily come out with the Aurum moſaicum. A large crucible may be made uſe of, if a larger quantity be required to be made at once. The operation cannot fail of ſucceſs, provided the fire be made of a ſufficient ſtrength, and of an equal degree from the bottom to the top of the crucible, which is eaſily done in a good furnace. The operation is finiſhed in eight hours, unleſs the volatile liver is wanted.

White arſenic, digeſted with a ſolution of tin in the acid of ſalt, becomes ſoon black; it does hereby regain its phlogiſton, and is reduced to the ſtate of regulus of arſenic, and will by this means readily combine with copper, and other metallick ſubſtances; which it would not do, without the help of phlogiſtic ſubſtances. This is the moſt eaſy and ready way of reducing arſenic to its metallick form: the arſenic may be deprived of the ſolution of tin, which adheres to it by waſhing it with water. It is to be dried ſlowly, for otherwiſe it is apt to catch fire.

A Method of dying Wool and Silk, of a yellow colour, with Indigo; and alſo with ſeveral other blue and red colouring Subſtances.

THE Saxon blues have been known for ſome time; and are made by diſſolving indigo in oil of vitriol,

vitriol, by which means the indigo becomes of a much more lively colour, and is extended to ſuch a degree, that it will go very far in dying.

A receipt for making the beſt Saxon blue will, I dare ſay, be agreeable to many; I will, therefore, give the following, which produces a very fine colour, and never fails of ſucceſs.

Mix ʒ 1 of the beſt powdered indigo, with ℥ 4 of oil of vitriol in a glaſs body or matraſs: and digeſt it for one hour with the heat of boiling water, ſhaking the mixture at different times; then add ʒ 12 of water to it, and ſtir the whole well, and when grown cold filter it. This produces a very rich deep colour; if a paler blue be required, it may be obtained by the addition of more water. The heat of boiling water is ſufficient for this operation, and can never ſpoil the colour; whereas a ſand heat, which is commonly uſed for this purpoſe, is often found to damage the colour, from its uncertain heat.

Indigo, which has been digeſted with a large quantity of ſpirit of wine, and then dried, will produce a finer colour than the former, if treated in the ſame manner, with oil of vitriol.

No one, that I know of, has heretofore made uſe of the acid of nitre, inſtead of the acid of vitriol; and it is by means of the former that the yellow colour is obtained: it was nevertheleſs natural to uſe it, on account of its known property of making yellow ſpots, when dropped on any coloured cloth.

The acid of ſalt does not diſſolve indigo, and therefore is of no uſe in dying.

Receipt

Receipt for making the yellow dye.

Take ʒ ½ of powdered indigo, and mix it in a high glaſs veſſel, with ℥ 2 of ſtrong ſpirit of nitre, previouſly diluted with ℥ 8 of water; let the mixture ſtand for a week, and then digeſt it in a ſand heat for an hour or more, and add ℥ 4 more of water to it; filter the ſolution, which will be of a fine yellow colour.

Strong ſpirit of nitre is liable to ſet fire to indigo; and it is on that account that it was diluted with water, as well as to hinder its frothing up. ℥ 2½ of ſtrong ſpirit of nitre will ſet fire to ℥ ½ of indigo; but, if it be highly concentrated, a leſs quantity will ſuffice.

If the indigo be digeſted twenty four hours after the ſpirit of nitre is poured on it, it will froth and boil over; but, after ſtanding a week or leſs, it has not that property.

One part of the ſolution of indigo in the acid of nitre, mixed with four or five parts of water, will dye ſilk or cloth of the paleſt yellow colour, or of any ſhade to the deepeſt, and that by letting them boil more or leſs in the colour. The addition of alum is uſeful, as it makes the colour more laſting; according as the ſolution boils away, more water muſt be added.

None of the colour in the operation ſeparates from the water, but what adheres to the ſilk or cloth; of conſequence this colour goes far in dying.

Cochineal, Dutch litmus, orchel, cudbear, and many other colouring ſubſtances treated in this manner, will all dye ſilk and wool of a yellow colour.

 The

The indigo which remains undiſſolved in making Saxon blue, and collected by filtration, if digeſted with ſpirit of nitre, dyes ſilk and wool of all ſhades of brown inclining to a yellow.

Cloth and ſilk may be dyed green with indigo; but they muſt firſt be boiled in the yellow dye, and then in the blue.

XVI. *Account of an extraordinary Steatomatous Tumour, in the Abdomen of a Woman, by* P. Hanly, *M. D. Communicated by* Charles Morton, *M. D. Sec. R. S.*

Received November 8, 1770.

Read Feb. 21, 1771.

MRS. Reily, aged thirty fix years, pale, tall, flefhy, and formerly of a healthy conftitution, was brought to bed of a ftrong, lively daughter, on the twenty third day of May, 1770, in the parifh of St. Anne, Dublin.

In the fifth month of her pregnancy, fhe felt an uncommon lump in her ftomach (as fhe expreffed it), about the fize of a hen-egg, which did not then give her much pain or uneafinefs, and fhe was in hopes that her delivery would carry it off: fhe had towards the end of her pregnancy frequent reachings, fometimes puked, and became emaciated; three days after fhe was brought to bed, fhe found the lump and reachings had encreafed; fhe became very uneafy, and fent for me.

Upon examining her abdomen, I felt a confiderable tumour contiguous to her ftomach, which afterwards had greatly encreafed, and was extended obliquely to her right fide, as low as her navel; it lay immediately under the peritoneum and abdominal mufcles, and in the progrefs of its encreafe, I could

 plainly

plainly feel one large, and other ſmaller protuberances of a firm ſubſtance, in ſome meaſure reſembling the head and ſuperior extremities of a fœtus, It could be eaſily moved from ſide to ſide, without giving her any pain; but it reſiſted, and made her uneaſy, when I attempted to move it downwards: her abdomen appeard plump and full, as if ſhe had not been brought to bed; but the hypochondres were more prominent and diſtended, than the region below her navel. I ordered for her the ſimple bitter infuſion with abſorbent powders, and delayed giving deobſtruent medicines, till ſhe had recovered her ſtrength after lying-in. I alſo deſired her not to ſuckle her infant; but, as her huſband was poor, ſhe did not comply, by which means ſhe quickly became greatly exhauſted and emaciated.

In a fortnight after her delivery, ſhe got up daily, walked about her room, ſometimes went abroad, and continued to ſuckle her child; but the reachings returned at intervals, the tumour increaſed in ſize, its protuberances became larger and more diſtinct, ſhe was often reſtleſs, and in pain at night on lying in bed, had a hectic fever, and daily became weaker and more emaciated, with a ſharp pinched-up noſe, hippocratic countenance, ſmall, quick, weak, thread-like pulſe, loſs of appetite, and night ſweats.

In five weeks after her delivery, the tumour had greatly increaſed in all its dimenſions; and its protuberances, which to the feel ſeemed to reſemble the head, trunk, and extremities of an extra-uterine fœtus, became more palpable and diſtinct, as the abdominal muſcles from their diſtenſion became thinner. I brought ten phyſicians, ſurgeons, and ac-

coucheurs

coucheurs to viſit her; and we were all ſo much deceived as to be of opinion, that the tumour was an extra-uterine *fœtus*: however, we were deterred from attempting the Cæſarean operation, from a conviction that ſhe was too weak, hectical, and reduced, to encourage any hopes of her recovery, in caſe it had been performed; and therefore we determined to leave the event to nature, eſpecially as we could perceive no motion of any particular parts of the tumour, though it had greatly increaſed, and as it was poſſible that it might be ſome other tumour.

She continued gradually declining; the tumour and ſymptoms increaſing, during May and June; and the twenty-third day of July following, I perceived a ſmall fluctuation of water in her abdomen, and gave her an intimation thereof, which determined her to procure another nurſe for her infant; but the aſcites daily increaſed, and in nine or ten days after, her legs and feet became œdematous, her night-ſweats ſtill continued, though her dropſy augmented, and ſhe languiſhed under the acute pains, more frequent reachings, hectic fever, loſs of ſtrength, want of appetite, and reſtleſs nights, except when ſhe took an opiate, which often proved a great relief and refreſhment to her.

Her poſture in bed now was half ſitting, half lying, which was the only poſition ſhe could bear without great pain and ſhortneſs of breathing.

About ſeven days before her death, ſhe was ſeized with a ſmart lax, which, in a few days, carried off part of the ſwelling in her left leg; ſhe became ſomewhat lighter, and leſs diſtreſſed in her breathing, which made her vainly hope, that her diſorder might be

be carried off in that manner; but the tumour, weakneſs, and other ſymptoms encreaſed, till the ſecond day of September inſtant when ſhe expired.

After her death, on opening her abdomen, in preſence of ſeven gentlmen of the faculty, we found about a gallon of water, and a large ſteatomatous tumour juſt under the peritoneum, near three inches in thickneſs, ſeven inches in length from her ſtomach to the obtuſe angle of her ribs, and in ſome places near five inches in breath from her ſternum to the vertebras of her back, full of prominences of different ſizes. It was of a hard conſiſtence, like tallow in its anterior part, but ſofter poſteriorly, and divided by thin membranes into numerous cells, which were diſtended with hard and ſofter fat; it weighed ſeven pounds, was of an irregular figure, adhered to, and compreſſed, the anterior part of her ſtomach, and was ſo firmly united to the inferior ſurface of the liver, that it could not be ſeparated from it without force. It preſſed and concealed the colon, and extended from the ſtomach by her liver to the right ovarium, and vertebras of her back: the ſmall guts were greatly ſqueezed, and moſtly forced towards the left ſide; and the anterior lobe of her liver was ſo compreſſed between the diaphragm and tumour, that it appeared flattened, ſmaller than uſual, and in a withered, decaying ſtate.

There was nothing præternatural in the matrix, or any of the other bowels; but they were greatly compreſſed, and the tumour, from its membranes and contained fat, ſeemed to be a production and diſtenſion of that part of the omentum, which adheres to the ſtomach, although it reached and ad-

hered

hered to the right ovarium, liver, aorta, and colon, as well as to the ſtomach.

The operator was for ſome time in ſearch of the colon, before he found it, adhering to, and almoſt forming a part of, the poſterior edge of the tumour.

Dublin,
Sept. 6, 1770.

P. Hanly, *M. D.*

Received February 4.

XVII. *A Letter from Dr.* Ducarel, *F.R.S. and F.S.A. to Dr.* William Watſon, *M.D. and F.R.S. concerning Cheſnut Trees; with two other Letters to Dr.* Ducarel, *on the ſame Subject.*

SIR,

Read Mar. 8, 1771.

IN a letter addreſſed to you, on the trees which are ſuppoſed to be indigenous in Great Britain, publiſhed in the *Philoſophical Tranſactions* *, the Hon. Mr. Daines Barrington has attacked a prevailing notion among the learned; that cheſnut trees are the native production of this kingdom. Mr. Barrington argues that they are not; and his reaſonings on this, are now to be conſidered.

In my Anglo-Norman Antiquities, p. 96. I had obſerved that "many of the old houſes (in Normandy) when pulled down, are found to have a great deal of cheſnut timber about them; as there are not any foreſts of cheſnut trees in Normandy, the inhabitants have a tradition, that this timber was brought from England: and there are ſome circumſtances, which, when rightly conſidered, will

* Vol. LIX. p. 23.

" add ſtrength to this tradition; for many of the old " houſes in England are found to contain a great " deal of this kind of timber: ſeveral of the houſes " in Old Palace Yard, Weſtminſter, and in that neigh- " bourhood, which were taken down in order to " build Parliament and Bridge-ſtreets, appeared to " have been built with cheſnut; and the ſame was " obſerved with regard to the Black Swan Inn, in " Holborn, and many other old buildings lately " pulled down in different parts of England." And to this I had ſubjoined the following account in a note. " Cheſnut timber being at preſent rarely to be " found growing in the woods and foreſts of Eng- " land, many perſons are induced to think that the " ſweet cheſnut was never an indigenous tree of this " iſland: but a little conſideration will plainly evince, " that it always was, and is to this day, a native of " England. It is generally allowed, that all the " ancient houſes in the city of London were built of " this timber. Certainly it did not grow far off; " and moſt probably it came from ſome foreſts near " the town; for Fitz Stephens, in his deſcription of " London, written in the reign of king Henry the " Second, ſpeaks of a large and very noble foreſt, " which grew on the North ſide of it. Rudhall, " near Roſs, in Herefordſhire, an ancient ſeat of the " family of Rudhall, is built with cheſnut, which " probably grew on that eſtate; for although no tree " of the kind is now to be found growing wild in " that part of the country, yet there can be no " doubt, but that formerly cheſnuts trees were the " natural growth of the neighbouring wood lands, " ſince we find that Roger earl of Hereford, founder

 of

" of the abbey of Flaxley, in Gloucesterſhire, " by his charter, printed in Dugdale's monaſticon, " tom. i. p. 884. gave the monks there, the tythe " of the cheſnuts in the foreſt of Deane, which is " not above ſeven or eight miles from Rudhall. " The words, are *Singulis annis totam decimam caſta-* " *nearum de Dena.* In the court before the houſe " at Hagley Hall, in Worceſterſhire, the ſeat of " Lord Lyttelton, are two vaſt ſweet cheſnut trees, " which ſeem to be at leaſt two, if not three hun- " dred years old; and Mr. Evelyn, in his Sylva, p. " 232. mentions one, of an enormous ſize, at Tortſ- " worth, in Gloucesterſhire, which hath continued " a ſignal boundary to that manor, from King Ste- " phen's time, as it ſtands upon record; and which " tree is ſtill living, and ſurrounded by many young " ones, that have come up from the nuts dropped " by the parent tree. Mr. Evelyn alſo aſſures us, " that he had a barn framed intirely of cheſnut tim- " ber, which had been cut down in its neighbour- " hood. In the foreſt of Kent, adjoining to Suſſex, " there ſtill remains ſeveral large old cheſnut ſtubbs, " which were left by the woodmen as *termini*, or " boundaries, either of pariſhes, or private property. " Beſides this, there are to this day, in the North " Eaſt part of Kent, ſeveral large woods, conſiſting " principally of cheſnut trees and ſtubs. In the " pariſh of Milton, near Sittingborne, is a manor " called Norwood Caſteney, otherwiſe Cheſteney, " from its ſituation among cheſnut woods, which " reach to the highway from London to Dover, and " give name to a hill between Newington and Sit- " tingborne, it being called Cheſnut Hill, the cheſ-

" nut

" nut trees growing plentifully on each ſide of it, " and in woods round it for many miles. And " by the particulars for leaſes of crown lands in " Kent, temp. Eliz. Roll III. N° 8. now in the " Augmentation office, it appears that there is, " in the ſame pariſh of Milton, a wood containing " two hundred and ſeventy eight acres and a half, " called Cheſton, otherwiſe Cheſnut wood. To " conclude, my worthy friend, Edward Haſted, eſq; " of Sutton atHone, near Dartford in Kent, F.R.S. " and F.S.A. aſſiures me that one of his tenants at " Newington, a few years ſince grubbed up forty " acres of wood, which were intirely cheſnut."

In the very out-ſet of the argument, Mr. Barrington impoſes upon himſelf, by changing the terms of the queſtion. " Since you ſent me, ſays he to Dr. " Watſon, the ſpecimen of ſuppoſed cheſnut, which " was taken from the old hall of Clifford's Inn, I " have been at ſome pains to examine the authority " for the prevailing notion, with regard to this be- " ing an indigenous tree" (p. 23.)—but in p. 24. he ſays, " I ſhall begin by conſideiing the proofs, which " are commonly relied upon to the *Spaniſh* or *ſweet* " cheſnut being indigenous in Great Britain."— though not one word has preceded, though not one word follows, of the Spaniſh and the common cheſnut being the ſame. He then alledges, " that the " very name of Spaniſh, ſeems ſtrongly to indicate " the country from which it was orignally introduced " here" (p. 24.) This is ſurely a ſtriking inſtance of an inaccuracy of language; the whole controverſy between us turns only upon that which is commonly called the cheſnut tree, and which is therefore de-

 nominated

nominated *Caſtanea Vulgaris*, by all the ancient Botaniſts. It is ſo called by Dr. Johnſon in his *Mercurius Botanicus:* by the ſame author, in his *Iter Cantianum*; and by Blackſtone, in his *Specimen Botanicum*; and in this true view of the controverſy, let us examine the principal parts of it.

I have, Sir, in the abovementioned quotation, particularly noticed a large tract of cheſnut woods, to continue to this day near Sittingborne, in Kent; in oppoſition to this, Mr. Barrington ſays, that he has taken a very minute inſpection of theſe woods; and that, "finding them planted in rows, and without "any ſcattering trees to introduce them, he is con-"vinced that they are not natives." (p. 27 and 28) Such is the argument by which my aſſertion is endeavoured to be ſet aſide.

I ſhall not here enter into an examination of the four general rules laid down by Mr. Barrington, "from which it may be decided, whether a tree is "indigenous or not in any country," p. 23. That I leave to the conſideration of two of my particular friends, who have entered into the Botanical reaſons produced by Mr. Barrington, and whoſe letters to me on this ſubject are hereunto annexed. I confine myſelf to the fact. "Remember, ſays Dr. Plot "in his MS. *Collectanea of Kent* (in the library of "Edward Jacob, Eſq; of Feverſham) the iron oar "ſmelted in Cheſnut wood, in the confines of Borden "and Newington." Dr. Johnſon, in his *Iter Cantianum*, 1632, ſpeaks of the *Caſtanea Vulgaris inter Sittingbourne et Rocheſter*. And this Cheſnut wood is equally mentioned as early as the 22d of Elizabeth, under the title of *Quædam Sylva, vocata Cheſtenwode*, in

in a conveyance, which the reader may ſee below (1). This wood then is not very modern; and if ever it was planted by any human hand, muſt have been planted two or three ages ago; but it was certainly never planted by any human hand; the whole wood

(1) Ex. Orig. penes Edw. Jacob Arm. de Feverſham, S.A.S. Nov. 22, 1770. Sciant p'ſent. et futur. q'd ego Georgius Clyfforde, p'ochie de Bobbynge in com. Kanc. ar. p' quadam pecunie ſumma michi p'fato Georgio p' Georgium Ffylmer p' manibus ſolut. unde fateor me fore ſolut. et content. dictumq; Georgium Ffylmer hered. et exec. et admynyſtr. ſuos fore exonerat. et acquietat. p' p'ſent. dedi conceſſi vendidi et hac p'ſent. carta mea confyrmavi eidem Georgio Ffylmer quinque acr. ter. et boſc. ſive majus ſive minus ſcituat. jacen. et exiſten. in pochia de Borden in com. p'dicto videl't ad quandam ſilvam ib'm, voc. Cheſten woode verſus Weſt ad ter.* Garret, gen'; verſus Southe ad ter. hered. Alexandr. Cottye; verſus Eſt ad boſcū hered. Henrici Droumfylde; verſus Northe; Eſt et Weſt ad boſcū Thome Pettenden, verſus North; H'end. et Tenend. predict. quinque acr. ter. et boſc. cum omnibus et ſyngulis ſuis p'tin. p'fat. Georgio Ffilmer hered. et aſſign. ſuis ad opus et uſum ipſius Georgii Ffilmer hered. et aſſign. ſuor. imp'p'etū Caplitib. d'no feodi p' ſervis inde eis prius debit. et de jur. conſuet. Et ego p'dict. Georgius Clyfford et hered. mei p'dict. quinque acr. ter. et boſci cum omnibus et ſingulis ſuis p'tin. p'fat. Georgio Ffilmer hered. et aſſign. ſuis contra omnes gentes warrantizabimus et imp'petū defendemus p'.p'ſentes. In cujus rei teſtimonium ego p'dictus Georgius Clyford huic p'ſent. cart. mee ſigillum meum appoſui; dat. viceſimo octavo die Maii anno regni dn̄e n̄re Elizabeth dei gra' Angl. Frauncie, et Hib. Regine fidei defenſoris, &c. viceſimo ſecundo.

Georgius Clyfforde, (L. S.)

Sealed and delivered
in the preſence of

German Wake, &
Henry Whithead.

* Sic Orig.

covers

covers more than three hundred acres of land. In one part of Chesnut wood, upon the hanging banks of Chesnut-street, and in the way from Kay-street to Stockbury, are now the remains of large chesnut trees and pollards, which were plainly planted by the bold irregular hand of nature.

I had also mentioned a grant (or rather a confirmation of a grant) made to the abbey of Flexeley, which was the tithe of chesnuts in the forest of Dean; "totam Decimam Castanearum de Denâ." But Mr. Barrington objects to the supposition "of "Dena, in the record, meaning the forest of Dean, "as there are so many places of the name of Dean "in the kingdom." This however is surely an objection of no weight. The Cistertian abbey of Flexeley, or Dene, was actually situated in the forest of Dean (2), and was anciently called Flaxlyn abbey of St. Mary de Dean (3). This abbey, together with Dean Magna (alias Mitchell Dean), and Dean Parva, all lie in the same hundred with the forest (the hundred of Saint Briannell), and are included in the ecclesiastical deanery, called Forest: where, therefore can the Dene of Flexely be placed, but at the forest in which it was situated, and from which it derived half of its appellation? And what pretence can a Dene in Hampshire, or a Dean in Lancashire, have to a place in a record, which relates only to the abbey of Saint Mary de Dene, in the forest of Dean? But all such reasonings are unnecessary: the point is ascertained beyond the possibility of a doubt, by Henry the Second's confirmation of the original

(2) Tanner's Notitia, p. 147.
(3) Atkin's Gloucestershire, p. 288. Edit. 1768.

grant,

grant, which may be ſeen below (4). The king, by this record, confirms to the monks, *locum qui dicitur Flexleia*

(4) Flexleyenſis Abbatia, in agro Glouceſtrenſi. Carta Henrici Normannorum Ducis, Donatorum conceſſiones recitans et confirmans.

H. Dux Normanniæ et comes Andegaviæ archiepiſc, &c. Salutem. Sciatis me conceſſiſſe et confirmaſſe Deo et Sanctæ Mariæ, et monachis ordinis Ciſtercienſis, pro ſalute anteceſſorum meorum, et mea propria, in elemoſinam perpetuam, omnes illas donationes quas Rogerus Comes Herefordiæ eiſdem monachis in elemoſinam dedit, juxta teſtimonium cartarum ſuarum, ſcilicet, locum quendam in valle Caſtiart, quæ dicitur Flexleia, ad conſtruendam abbatiam, et totam terram illam quæ dicitur Waſtadene, quæ fuit Walfrici, et quandam fabricam ferrariam apud Edlandam, et totam terram ſub veteri Caſtello de Dena ad ſartandam, et illam quæ eſt aſſartata, et quandam piſcariam apud Redliam, quæ dicitur Newerra, et quoddam pratum in Pulmede, et omnia aiſiamenta ſua in foreſta de Dena, et dominicum totum de Dimmoc, et terram illam quæ fuit Uthredi clerici, et terram Ernaldi, et terram Wolfrici, ita ſcilicet, quod ipſe Uthredus clericus remaneat in manu abbatis, cum eſcambio ſuo, ſcilicet duabus virgatis terræ quod nemini inde reſpondeat niſi abbati; et dimidium nemus apud Dimmoc; et ſingulis annis *totam decimam Caſtanearum de Dena*, et terram illam quam adquietavit ipſe Comes Herefordiæ de Gaufrido filio prædicti Wulfrici, et aliam quam ipſe Comes adquietavit de Leſfrico, de Strattra. Quare volo, &c. Nos autem has prædictas donationes non tantum eis confirmo, ſed etiam omnes alias quas idem Rogerus Comes Herefordiæ illis in elemoſinam daturus eſt. Teſtibus Rogero Comite Herefordiæ, Willielmo de Crivecuer, Ricardo de Humet, Conſtab. Philippo de Columbariis, Roberto de Ivigum, Willielmo de Angervill, Willielmo Cumin, apud Eveſham.

Cart. Antiq. X. Num. 4.

Carta regis Henrici Secundi.

Henricus, Dei gratia, Rex Angliæ, et Dux Normanniæ et Acquitanniæ, et Comes Andegaviæ, Archiepiſcopis, &c. et omnibus fidelibus ſuis Anglis et Normannis, tam præſentibus, quam

Flexleia ubi abbatia fundata est, by the title of *Locum quendam in foresta de Lenâ.* He afterwards goes on, to

quam futuris, salutem. Sciatis me dedisse et confirmasse Deo et Beatæ Mariæ et Monachis meis de Dena, quos in propria protectione suscepi, pro salute mea et antecessorum meorum, in elemosinam perpetuam, locum quendam in foresta de Dena, videlicet, totam vallem de Castiard, et locum qui dicitur Flexleia, ubi abbatia fundata est de ordine Cisterciensi, in honore beatæ virginis Mariæ, pro amore Dei, et pro anima regis Henrici avi mei, et Comitis Gaufridi Andegaviæ patris mei, et Matildis imperatricis matris meæ, et aliorum parentum et antecessorum meorum, et pro salute mea, et hæredum meorum, et pro stabilitate et pace regni Angliæ. Concessi etiam eis et confirmavi omnes illas donationes quas Rogerus comes Herefordiæ eisdem in elemosinam dedit sicut cartæ ejus testantur. Præterea dedi eis et confirmavi omnia aisiamenta in eadem foresta mea de Dena, scilicet pasturam juvencis suis et porcis suis, et omnibus aliis pecoribus suis, et ligna et materiem ad domos suas et ad ædificia sua facienda, et ad alias res usui suo necessarias, sine vasto in eadem foresta mea. Et de eadem foresta dedi eis *decimam castanearum mearum*, et grangeam quæ dicitur Wastedena, et unam forgeam ferrariam, ita liberam et quietam et operantem, per omnia, sicut meæ dominicæ forgeæ. Et totam terram sub veteri castello de Dene ad sartandam, et illam quæ est assartata; videlicet, centum acras, et quandam piscariam apud Reidleiam, que dicitur Nolwerâ, et quoddam pratum apud Reidleiam, quod vocatur Pulmede; scilicet quatuor acras, et terram quam illis dedit in elemosinam Leuvericus de Staura, et grangiam quam eis dedi apud Wallemere, de assartis meis; videlicet, ducentas acras, cum pratis et pascuis, et omnibus aliis aisiamentis, et quatuor acras de Northwoda, et totam dominicatum meum de Dimmoch, et quinque virgatas terræ et dimidiam, præter dominicatum, et dimidium nemus meum de Dimmoch, et dimidium retium in manu mea, propter aisiamenta hominum meorum, ea scilicet de causa, ut monachi mei habeant suam partem nemoris in bene et in pace, et sine omni communione aliorum hominum; et firmiter præcipio, ut nullus eos super hoc inquietet. Præterea dedi eis essartum quoddam subtus Castiard, quod vocatur Terra Vncentii. Hæc omnia dedi

to give them *omnia aſiamenta in eadem foreſta mea de Denâ*; and then he particularly ſubjoins, et de *eadem foreſta* dedi eis *Decimam Caſtanearum mearum*. Can any words poſſibly be more explicit than theſe? And can Mr. Barrington aver againſt the teſtimony of an authentic record? But, though the Dena of the record does mean the foreſt of Dean, Mr. Barrington has ſtill an objection in reſerve; and aſſerts that "there are not the leaſt veſtiges of any ſuch trees in "this foreſt at preſent." (p. 29.) But is Mr. Barrington ſure there are no veſtiges of cheſunt trees in the foreſt? Did Mr. Barrington inſpect into every part of this ample area? And did no trees, no ſtumps, no ſtools, eſcape his eye in this wide unbounded range? But the fact appears otherwiſe. There are not merely ſtumps, not merely ſtools, of cheſnut trees; but actual and abſolute trees of cheſnut exiſting at this day, in the foreſt of Dean.

In a letter to me, dated Dec. 10, 1770, from the Rev. Mr. William Crawley, reſident at, and miniſter of Flaxley (uncle to Thomas Crawley Bovey, Eſq; the preſent owner of Flaxley abbey); is the following account:—"In this very foreſt and "near Flaxley is a parcel of land, about three or

dedi Deo et beatæ Mariæ et monachis meis Deo devote ſervientibus, habenda et tenenda imperpetuum, ſoluta et quieta ab omni reguardo et exactione ſeculari. Quare volo, &c. Teſte Ricardo de Humet, Willielmo de Creveca, Philippo de Columbariis, Willielmo de Angervill, apud Eveſham. (Monaſticon Anglicanum, Tom. I. p. 884).

Pat. 22 R. II. part 3. m. 16. per Inſpex. Vide Cart. antiq. N. N. 30. Et pat. 27 H. VI. par. I. m. 9.

" four hundred acres, which is ſtill denominated
" *cheſnut:* though neither cheſnut, nor any other
" kind of tree is to be ſeen there, excepting what
" we call underwood or coppice, moſtly hazel. In-
" deed in many places of the foreſt, I find cheſnut
" trees are (ſparingly) to be met with; but within
" a few yards of the above ſpot, in a wood of my
" nephew, are many of remarkable fine growth."
But, even if the fact had been as Mr. Barrington hath ſtated it, the faith of a record atteſting the exiſtence of cheſnut trees formerly, in the foreſt of Dean, was ſurely not to be ſuperſeded by the non-exiſtence of ſuch trees at preſent; they might have exiſted formerly, though they do not exiſt at preſent. And the record explicitly aſſures us that they did exiſt, and as early at leaſt as the reign of Henry the Second.

The cheſnut tree, therefore, may ſtill claim a natural relation to this iſland, notwithſtanding the two arguments of Mr. Barrington againſt it: and if we look into this kingdom, we ſee the cheſnut tree, not confined to Sittingbourne woods, or to Dean foreſt; but ſcattered with a free hand, through many parts thereof; ſhooting up with all the healthy vigour of genuine natives, and giving denomination to ſeveral places amongſt us. Thus the cheſnut wood of Sittingbourne, has given the name of Cheſnut-ſtreet, to the neighbouring road; and the old Saxon half of the name, Street, ſtrongly intimates the other half to be very ancient. The appellation occurs in the firſt map, that notices the names of the roads, the map of Kent by Morden. In Hertfordſhire is a town, called in old writings, Cheſton, Cheſthunte, Sheſterhunte, and Ceſtrehunt; and Norden (in his

diſcription of Hertfordſhire, p. 15,) ſays, Cur non (5) Cheſtin? Caſtanetum of Cheſſe-nut trees?'

The Saxons were well acquainted with this tree, and, according to Skinner and Lye, called it Cyſtel and Cyſt-beam; the ſame word evidently with our preſent Cheſ-nut. Dr. Johnſon, in his *Mercurius Botanicus*, 1634, remarks the cheſnut to have been not unfrequent in the woods, as well as in the plantations, of his own times; *Caſtanea Vulgaris in ſylvis nonnullis et viridariis*;—Mr. Dale, in his *Hiſtory of Harwich*, mentions various cheſnut trees to be growing in Stour wood, within the pariſh immediately adjoining to Harwich. Blackſtone, in his *Specimen Botanicum*, p. 12. ſpeaks of cheſnut trees growing in (6) Bulwin woods, between Dartford and Bexley, in Kent, plentifully; not twenty miles diſtant from London. Mr. Philipot, in his *Villare Cantianum*, which was printed in 1659, ſays in p. 237. "There "is a manor, called Northwood Chaſteners, which "name complies with the ſituation; for it ſtands North "from the town, in a wood where cheſnut trees "formerly grew in abundance." "The noble cheſ-"nut tree, ſays Morton, (Northamptonſhire, p. 397.) "belonging to the Worſhipful Thomas Tryſt, Eſq; "of Marford, is the largeſt of that kind I have any "where ſeen: the body of it is no leſs than fifteen "feet eight inches in circumference; and it extends "its branches proportionably." "On the outſide of "the Roman ſtation at Temple Brough, near Sheffield, "in Yorkſhire, ſays Gibſon's Camden, (Vol. II. p. "847.) "is a large bank, upon which are huge trees, "and upon the ſide of the bank of the highway,

(5) Cheſtin. (6) Now Baldwyn Woods.

 "there

" there grew a chesnut tree that had scarce any bark " upon it, but only upon some top branches which " bore leaves; it was not tall, but the bole could " scarcely be fathomed by three men." " There was " standing, says Evelyn (in his *Sylva*, Fol. London, " 1706, p. 223.) an old and decayed chesnut at " Fraiting, in Essex, whose very stump did yield " thirty sizeable loads of logs. I could produce you " another of the same kind in Gloucestershire, which " contains within the bowels of it, a pretty wain-" scotted room, enlightened with windows, and " furnished with seats, &c." And to these we may add two great chesnut trees flourishing at Tortworth, in Gloucestershire, and at Writtlepark, in Essex; the former is allowed, even by Mr. Barrington, " to be " the oldest tree that we have any account of, per-" haps in Europe." (p. 30.) And the following description of both, was published about twelve or thirteen years ago (7); " At the seat of the Lord " Ducie, at Tortworth, in Gloucestershire, there is " now growing an English chesnut, which measures " fifty one feet about, at the height of six feet above " the ground. This tree divides itself, at the crown, " into three limbs, one of which measures twenty " eight feet and half in the girt, and five feet above " the crown of the tree. The soil is a soft clay, " somewhat loomy; the situation is the North West " side of a hill; this tree was stiled, in King John's " time, the great and old chesnut tree at Tortworth; " so it is supposed to be now above one thousand " years old."

(7) London Magazine, 1758, p. 482.

" There

"There is another ſtately cheſnut (8), but little "inferior to that at Torteworth, in Writtle park, "three miles to the left of Ingateſtone, in Eſſex. "The late Lord Petre meaſured this tree, and found "it forty five feet girth, five feet from the ground; "this vaſt trunk ſupports a lofty head, which, at a "diſtance, affords a noble proſpect, and well de-"ſerves to be ſurveyed by all that admire ſuch "wonderful productions." At Little Wymondley, near Hitchin, in Hertfordſhire, is an old decayed cheſnut tree, the trunk whereof (meaſured within theſe two years) was found to be forty two feet circumference in one part, and forty eight feet in another, as I am credibly informed.(9) And, to give additional force to an argument which is already deciſive of itſelf, we may obſerve, that in the New Foreſt, there are very many cheſnuts irregularly ſcattered among the oaks and other trees; and now to be ſeen in the road from Limington to Southampton.

In this great abundance of cheſnut trees formerly among us, we need not wonder that cheſnut timber was frequently uſed in old houſes, preferable to oak; it was then the timber moſt eſteemed by our joiners and carpenters. And, though very laſting, yet it has been juſtly diſcredited, in theſe later ages, for houſes, becauſe, when it begins to decay, the conſumption commences at the core, and the heart is the firſt deſtroyed. And we can produce ſome

(8) In a News Paper, called The Citizen, or General Advertizer, Sept. 21. 1758.

(9) This tree is ſituate in the grounds, and near the houſe of Little Wymondley Bury, late the eſtate of Lord Groſvenor, but purchaſed within two or three years by Col. Cracherode.

proofs,

proofs, additional to the many that have been formerly produced, of chesnut timber actually employed in buildings. "The old houses in the city "of Gloucester (as the Reverend Mr. Crawley informs me that he has often been assured) are "constructed of chesnut, derived assuredly from the "chesnut trees in the forest of Dean." In many of the oldest houses at Feversham is much genuine chesnut, as well as oak, employed. In the nunnery of Davington, near Feversham (now entire), the timber consists of oak intermingled with chesnut. And the great chesnut beam which supported the leads of the church tower at Feversham, when it was lately taken down, was found rotted for many feet at the extremity; and had, as it were, a mere shell of sound timber remaining about it.

Thus have I endeavoured, with all the respect due to genius and truth, to point out some of the mistakes into which, I apprehend, Mr. Barrington has fallen. I might have dwelt more largely upon the antiquarian part of my subject; but the botanical was more immediately my point. And in the examination of this, I have shewn, that the chesnut tree flourishes greatly in this kingdom; that it appears wildly scattered over the face of the country; that it was actually settled among us many centuries ago; and used by our ancestors in buildings; and that it was even familiarly known to the Saxons. All these united evidences strongly co-operate to prove it a native of this island, and must absolutely be allowed to prove it, till Mr. Barrington, or some other person, can produce superior evidence to the contrary.

I beg

I beg leave to ſubmit theſe obſervations to your conſiderations; and have the honor to remain,

SIR,

Your moſt faithful

humble ſervant,

Doctors Commons,
Jan. 5, 1771.

And. Coltee Ducarel.

XVIII. *Copy*

XVIII. *Copy of Mr.* Thorpe's *Letter to Dr.* Ducarel, *concerning Chesnut Trees.*

Dear Sir,

Read March 8, 1771.

HAVING perufed the Hon. Mr. Barrington's letter to Dr. Watfon, publifhed in the Philofophical Tranfactions, I find he lays down three or four general rules to determine whether a tree is indigenous or not in any country, as follows:

"I. They muft grow in large maffes, and cover "confiderable tracts of ground; nor muft fuch woods "end abruptly by a fudden change to other trees, "except the fituation and ftrata become totally "different.

"II. If the trees grow kindly in copfes, and "fhoots from the ftool, it muft for ever continue in "fuch a wood, unlefs grubbed up, nor is it then "eafily extirpated.

"III. The feed muft ripen kindly: nature never "plants but where a fucceffion may be eafily con-"tinued, and in the greateft profufion.

"Laftly, many places in every country muft re-"ceive their appellation from indigenous trees, which "grow there, &c. When the inftances of this are

"fingular,

"singular, it will prove directly the contrary, as he "hopes to shew with regard to the chesnut, &c."

In answer to his objections, and agreeable to these his forgeoing rules; I shall endeavour to prove the chesnut to be an indigenous tree, in this island; and 1st, Mr. Barrington says, that he examined the woods near Sittingbourn himself; "and on a very "minute inspection of them, found those parts which "consist of chesnuts, to be planted in beds or rows, "about five yards distant from each other; nor are "there any scattering trees to introduce them, &c."

In what wood or woods, he observed these plantations, I must confess, I am quite at a loss to find, having never observed this regularity in any of the woods I have been in; and I very lately asked a person who has lived many years in that neighbourhood, deals largely in timber and underwood, and is over all these woods every year, who told me he knew of no such regular plantations in any of them; that the chesnut grew intermixed with other trees, as in all ancient woods.

Indeed, the amazing distance of the plants from each other, which Mr. Barrington mentions, is somewhat extraordinary; as the usual custom now, in planting sets of chesnut or ash, for hop poles, is about seven or eight feet distance, as has been lately done by John Cocking Sole, Esq; in his plantation of chesnuts, at Newington.

The woods, called the Chesnut woods, the property of the Earl of Aylesford, which lie in the parishes of Newington, Borden, and Bobbing, abound with these trees, which grow promiscuously with others, both from stubs and stools of a large size;

 twenty

twenty acres of which are annually felled for poles, &c.

Cranbroke Wood, belonging to Mrs. Mercer, in Newington, has the chefnut in plenty with other trees, which produce poles in abundance, from old ftubs and ftools.

The Squirrel Wood, the property of the Hon. Mr. Roper, in the parifh of Stockbury; thofe called Long Tun and Binbury, contain plenty of chefnut, intermixed with other trees, in which are very large chefnut pollards; to appearance fome hundred years ftanding; which grow on a poor foil, and are quite hollow fhells, having no nourifhment but from the rind or bark; yet throw out plenty of fhoots from the roots.

I have a farm in the parifh of Stockbury, called Nettlefted, forty acres of which are tithe free, which portion of tithes belonged to the great monaftery of St. Auftin, fituated without the walls of Canterbury. They were given in very ancient times to the ufe of the almonary or almonry of that abbey; as far back as the time of Archbifhop Walter, in the year 1193, how long before is uncertain, and are mentioned by William Thorn, a monk of that houfe, and publifhed by Sir Roger Twifden, in the Decem Scriptores; part of thefe tithes are woodland, and to this day called Almery or Ambry-Tanton. In this wood are very old ftools of chefnut, fome of which are ten feet circumference, and ftand promifcuoufly with oak, afh, and other trees. Thefe ftools yet produce very good poles, which were felled once in my father's time, and have twice fince they have been in my poffeffion.

In

In ſhort, all that vaſt range of woods, called Stockbury vallies, which extend from Key-ſtreet to Binbury Pound, produce the cheſnut in common with other trees; the woods formerly belonging to the abbey of Leſnes, founded by Richard de Lucie, chancellor and chief-juſtice to Henry II. in the pariſh of Earith, ſtill called the Abbey woods, having great plenty of cheſnut, both timber and ſtub wood, and from the ſtumps and ſtools of large timber trees formerly felled, which ſtools are now quite hollow and decayed, except the outward bark or ſhell, round the crowns of which ariſe many ſtools, and are cut for poles at the proper growth.

Church wood, in the ſame pariſh, has the like; and many others in this neighbourhood.

In Wrotham pariſh above Kemſing, is a wood belonging to a farm, called Cottons, which has cheſnut intermixed with other trees.

I could enumerate many more in different parts of this county, was it neceſſary; and I make no doubt, on due inſpection, the like may be found in other counties of this kingdom: it is moſt certain, the cheſnut does not grow in every wood, but in ſuch only, where the ſoil is adapted to it. Different ſtrata will produce different trees; as for example, the great wood called Jordens, in the pariſhes of Bexley and North Cray, the woods beyond Ruxley towards Farningham, have ſome acres nothing but birch, ſome only hazel, &c. Godden-wood, in the pariſh of Seal, is intirely birch. The woods on the Cold hills, of Chelsfield and Nockholt, run moſt upon beech; and thoſe in the Weald of Kent, upon a clayey ſoil, are chiefly oak.

 In

In anſwer to the third and laſt general rule; that the nuts of the cheſnut tree ripen kindly, and in great quantity, is manifeſt from the numbers of poor people at Earith, and the adjoining hamlet; going into the woods at the proper ſeaſon, and gathering ſome a quarter, others three ſacks each, to fat their hogs, eſpecially when pulſe and grain are dear. It is true, the nuts are not ſo large as on trees which ſtand ſingle and open to the ſun, in parks, courts, &c. Even the oak will not produce acorns in a wood, till it becomes an old tree; and then not ſo large and in ſuch plenty as on old trees and pollards which ſtand open in fields and hedge rows. But where the cheſnut, as before obſerved, ſtands ſingle and planted for ornament, as in the Wilderneſs park, the ſeat of Mr. Prat, in Seal; and in Bradbourn park, the ſeat of Sir Roger Twiſden, Bart, at Eaſt Malling, and divers other places, the nuts are large, well taſted, and in great plenty, yielding excellent food for the deer.

It is well known that trees cloſe planted in orchards will not produce fruit ſo large and fair, as in kitchen gardens, where they ſtand ſingle, are often digged about, and manured.

Mr. Barrington himſelf ſays, Dr. Watſon informed him, "that in Spain the cheſnut trees deſtined to "produce the beſt fruit, are engrafted upon the "wild cheſnut; and that the French call the com- "mon ſort Chataignier, and the improved one "Maronier." If ſo, the latter may be the ſort which are annually brought to England, and ſold at all the fruit ſhops, &c. and are called Spaniſh cheſnut. Mr. Barrington ſays, "the very name of Spaniſh, "ſeems

" ſeems moſt ſtrongly to indicate the country from " which this tree was introduced here." But why Spaniſh? I do not know that it is any where here ſo called, and none of the wood-men know it by that name. The old Botanical writers, John Bauhine, Gerhard, and Parkinſon, call it Caſtanea Vulgaris. Caſpar Bauhine, in his Pinax, Caſtanea Sylveſtris, the common or wild cheſnut tree. Ray indeed, in his Synopſis, the 3d Edit. publiſhed by Dillenius, p. 449, has the following, " in ſylvis quibuſdam prope " Sittingburn Cantii oppidum, & Woburn Bedfordiæ, " obſervavimus an ſpontaneam, an olim ibi ſatam, neſ- " cimus." It is ſomewhat ſtrange that ſo celebrated a Botaniſt ſhould treat of it in ſo ſlight a manner, and with ſeemingly ſo little attention, as to mention it only in thoſe two places.

Laſtly, Mr. Barrington ſays, " that many places, " in every country, muſt receive their appellation from " indigenous trees which grow there, &c."

There are many trees which give few, if any, appellation to places. It does not therefore follow that they are not indigenous. In ancient time, England abounded more in woods and foreſts than at preſent; and the oak and aſh being then two of the moſt common trees, occaſioned the names of the contiguous places and pariſhes to receive their derivation.

Notwithſtanding his trial of the ſpecimens of oak and cheſnut, I am well aſſured many old buildings were, and are, of the latter; eſpecially in places where theſe trees flouriſhed. When I repaired the old houſe at Nettleſted, in Stockbury, in ſawing off the end of the main girder, it was decayed at heart; and

and pronounced by the furveyor and carpenter then prefent to be chefnut, as are the other timbers.

Cowfted, a very ancient feat in the fame parifh, is intirely of that wood; and Dr. Stukely, in his letter to the late Lord Hardwick, read at the Society of Antiquaries, and fince publifhed in the Archæologia, p. 44. fays, "the curious roof of the large hall "of the manfion houfe at Lefnes is of chefnut, which "no doubt was felled in the abbey woods there."

In latter times, the feat called Mount Mafcal, in the parifh of North Cray, rebuilt by Sir Comport Fitch, Bart. about fourfcore years fince, the girders and large timber of which are, as I am well informed, of chefnut felled in the woods adjoining.

And why fhould it not have been ufed in buildings, feeing it is very durable, and grows to a great fize? witnefs the fine trees felled laft fummer, together with fome oak and beech, in the park of Penfhurft in this county; poffibly in length of time, the characteriftick of the chefnut trees decaying inwardly, might be the reafon of the oaks being moftly ufed, as the more durable timber; and the former found to turn to better account for underwood and poles; efpecially when hops came into ufe in Henry the Eighth's time, and are the beft for that purpofe. Even oak, by reafon of its fcarcity and dearnefs, is now little ufed in publick buildings; fir-timber altogether fupplying its place.

The chefnut tree yet alive in the court at Tortworth, in Gloucefterfhire, fuppofed by Evelyn and Bradley to have been planted in the time of King John, may poffibly be the oldeft tree of the kind extant in this kingdom; but is no proof of there

not

not being chesnut trees before that time: Any more than the famous tree called Bears oak, in the park at Penshurst abovementioned; or the well-known tree called Fisher's oak, in the parish of Farnborough, in this county; or that in Welbeck park, the seat of the Duke of Portland, were some of the first trees of that kind here planted; the situation and ornament of these trees protected them from the axe.

The common elm, Evelyn thinks not to be an indigenous tree, and it may not as it is seldom, if ever, found growing in woods; but in road ways, hedge rows, &c.; and not in the North of England, though, as Mr. Ray observes, some trees are only found in the North, some in the South, and others in the West; neither does the elm, when an old tree, shoot kindly from the stool.

I agree with Mr. Barrington, that the box tree is an exotick; but the yew is certainly indigenous, as I think may be easily proved, and which he assents to, but doubts whether the euonymus or spindle tree, and ligustrum or privet, are so; most certainly they are, as no shrubs are more common on dry banks, and in hedges, &c.: but, as he assigns no reason for their not being indigenous, I shall dwell no longer on that subject, and conclude,

Dear Sir,

Your most humble servant,

J. Thorpe.

Bexley,
Nov. 26. 1770.

XIX. *Extract*

XIX. *Extract of a Letter from* Edward Hafted, *Efq; F. R. S. and F. S. A. to Dr.* Ducarel, *concerning Chefnut Trees.*

Dear Sir,

Read March 8, 1771.

IN anfwer to Mr. B's 1ft rule—I muft remark, inftances are exceeding frequent of woods and coppices breaking off, by a fudden change, to other trees, and that where the fiutation and ftrata are entirely the fame; fometimes without any mark of divifion, and fometimes with a ditch only, an old ftub for a boundary, or perhaps diftinguifhed only by the difference in the growth of the underwood, or the like. It is a known fact, that particular forts of trees have grown in large tracts and maffes in a country, which have been in fucceeding times almoft extirpated from thence, either from others being more diligently encouraged and preferved, or from the prefent deftructive method of too frequent cutting them down; and only fcattered ftubs or trees have remained of the fort, thinly difperfed in woods and hedges. The wich, elm, maple, and others, are indigenous trees; and yet feldom, if ever, grow in large maffes, or cover confiderable tracts of ground; the reafon of

 which

which is, they never ſhoot from the ſtool ſo as to make any conſiderable progreſs.

As to the 2d—A tree, or particular wood, may grow very kindly in a coppice, and yet in proceſs of time, by the continual felling of the wood, may be entirely worn out, when other ſorts, which bear the woodman's cutting-bill more kindly, will increaſe, and overrun the former, ſo as to fill every vacancy made by it. Beſides, there are ſome kinds of wood which are poiſoned, and in time decay by the near affinity of others. The aſh is a particular inſtance of this poiſonous quality towards other trees.

As to the 3d rule of ſeeds ripening kindly; I muſt diſagree in this too, as I find very few, if any, whether indigenous or not, whoſe ſeeds do not ripen here ſufficient to continue the tree eaſily; and where it is not in profuſion, the indigenous tree will be found as deficient as ſome others, which are known to be otherwiſe.

Mr. B's laſt rule, of places taking their name from indigenous trees which grow there, may ſerve as well to prove all trees whatſoever ſo: there being but few trees which have grown in Britain, but our very ingenious etymologiſts have derived the names of ſome places from them.—Singular inſtances, I own, I do not recollect.

All kinds of things in general adopt the name of that country where they grow, or are made in the greateſt perfection.—Inſtances of this are obvious in every neceſſary of life. The cheſnut, whoſe fruit ripens in Spain in much more perfection than in this variable and colder climate, has gained the additional name of Spaniſh to it, among the merchants

 and

and venders of them, though in the country villages the woodmen will yet talk of the growth of this right ENGLISH CHESNUT. And as to Pliny's telling us that chefnuts were brought from Sardis to Italy long before his time; that does not make it lefs probable that they might have been the growth of Britain, at the very time they were brought from thence to Rome.

The ancient Norman buildings are moftly of this wood, which in all probability was fetched from this country; moft of the ftone wherewith our monafteries and buildings of fuch fort were erected came from Normandy. This feems to have been a mutual traffick for fome centuries between the two countries.

How the notion arofe firft, that the foreft mentioned by Fitz-Stevens to the Northward of London, was moftly of chefnut, I do not know, nor could I ever find any authority for it; though it continues the affertion of moft literary men. If I might conjecture, I fhould think it to have arifen from a blunder and miftake of the name of Norwood; there being many decayed ftubbs of chefnuts in the archbifhop of Canterbury's Norwood, not far from London; which is, no doubt, the place Mr. Miller means, when he mentions fuch having been feen in the neighbourhood of the metropolis.

Moft antiquarians affert that Old London was built of chefnut: that this tree grew near London, has been proved above from Norwood, and may from the name of Chefhunt, in Hertfordfhire; that it may have done fo in former times in great plenty, might be fuppofed from what I have faid before; but one

reaſon of its decay may be aſſigned to the great increaſe of the metropolis, which conſumed moſt of the cheſnut timber near it; and the ſtubbs of ſuch being much ſubject to decay, few, if any of them, could naturally laſt to this time, ſo as to bring any profit to the owner, but have been grubbed up from time to time, till they are now almoſt totally eradicated; and I think, there is great probability that the univerſal decay and deſtruction of this kind of timber, throughout the realm, appeared in ſo ſerious a light to the legiſlature, as to give the firſt riſe for our laws for the preſervation of timber in general.

Oak timber is ſo entirely different from cheſnut, in the rings and ſpaces, which appear when cut tranſverſely, that it is impoſſible to miſtake the one from the other.

In a note, p. 96. of the Anglo-Norman antiquities, mention is made, of a large tract of cheſnut woods, near Sittingbourne, in Kent (and in the North Weſt part of Eaſt Kent, as it ſhould be printed), which is certainly right; theſe woods are a very large tract, which more or leſs have cheſnut ſtubbs ſpread over the whole ſpace of them. They extend ſome miles, from the environs of the town of Milton, by the old highway (now diſuſed), leading from thence to Maidſtone. The general name of the whole tract, is Cheſnut or Cheſtney Woods. The 40 acres mentioned in the ſaid note to have been grubbed up, were only felled; and were of ſuch a ſize and growth, as to be moſtly uſed as timber. On the top of Cheſnut Hill between Newington and Sittingbourne, there ſtood a cheſnut tree of prodigious ſize, which has been felled within theſe few

years, the ſtool of which may now be ſeen cloſe to the high road.

The production of nature in this vaſt tract of woods is ſo plain, that it would be abſurd to uſe arguments to defend it; nor ſhall I bring examples of it from other countries, which might be had: I ſhall only take notice, with Dr. Ducarel, that in the ancient foreſts of Kent, which lay to the ſouth of it, adjoining to Suſſex and Surry, there remain large old cheſnut ſtubs or brocks, now almoſt worn out, and periſhed, which are left by the woodmen as termini or boundaries, either of pariſhes or of private property; which is the univerſal cuſtom every where made uſe of to diſtinguiſh the wood of different owners, and are never cut down or altered; ſo that they muſt have ſtood ſacred to this uſe, from the firſt introduction of private property into this iſland; and were no doubt even then of conſiderable age, by their being made choice of for this uſe, in preference to any others.

But to return to the neighbourhood of Milton.—The manor of Norwood, within that pariſh, is called, in the higheſt records we are acquainted with, Norwood-Cheſtney, Chaſtney, and Caſtney, no doubt from the great plenty of cheſnut within its bounds, even in thoſe early times. Nor is this a ſingular inſtance of any place in England being named from the cheſnut tree; Cheſhunt, in Suffolk; and Cheſhunt, in Hertfordſhire, having both their names from the plenty of cheſnuts near them: the laſt of theſe places, Chancy tells us, ſeems in old time to have abounded with them; and that moſt of the ancient houſes in that vill were built of them; and in the venerable

nerable book of Doomſday, we have an account of a quantityof woodland in this pariſh, ſufficient for the feeding of 1200 hogs, which ſhews us that this conſiderable tract of wood was of ſuch ſort, as to afford plenty of good food for ſwine; as it certainly muſt be to afford pannage for ſo large a number; and that theſe woods were cheſnuts, may in all probability be preſumed from the above circumſtances.

The ſame venerable record likewiſe mentions the village of Box, alias Boxbury, in Hertfordſhire; which, the learned Serjeant tells us, was ſo called from a large wood, which retains the name to this day; and I have now before me the names of more than a dozen pariſhes and places, which have taken their names from the box tree, and retain it to this time. The fir, no doubt, from every evidence that can be had of former times, and by the evidence of our own eyes, from the numbers of them which have been dug up in almoſt every part of Britain, was an indigenous tree of this county; notwithſtanding Cæſar's aſſertion to the contrary, who appears to have been but little acquainted with it, when he tells us, "this iſland had every kind of "tree the ſame as Gaul, except the fir and the "beech;" both of which were in the greateſt plenty here at that very time; the latter was particularly ſo within the county of Kent, the only ſpot he might be ſaid to be acquainted with: and yet, after this, no one ſure will aſſert that either of theſe trees are not indigenous; though the former of them is entirely extirpated (as the production of nature) from the Southern part of Britain, which the cheſnut is not; though it is made uſe of as an argument againſt

its

its being the natural product of this country. The elm bears every mark of its being indigenous; and, according to one of Mr. B's general rules, it must be so, for there are near 40 places in England, which take their name from this tree, most of which are mentioned in the book of Doomsday.

Whoever has been much acquainted with the woods and tracts of ground lying on our Chalky Hills, will surely never contend that the yew is not the indigenous growth of this country. I am,

Dear Sir,

Yours, &c.

Huntingfield, in Kent,
Nov. 29, 1770.

Edw. Hasted.

XX. *A Letter from the Hon.* Daines Barrington, *F.R.S. to* Mathew Maty, *M.D. Sec. R.S. occasioned by the three preceding Letters.*

DEAR SIR,

February 15, 1771.

Read March 8, 1771.

I HAVE lately had an opportunity of perusing three letters from Dr. Ducarel, Mr. Thorpe, and Mr. Hasted, which contend that the sweet chesnut is an indigenous tree of this country, and which are intended to be communicated to the Royal Society.

As I do not see any reason for altering the opinions which I have happened to form on this subject, from what is contained in these three letters, I should not trouble the Society with any answer to the contents of them, did not Mr. Thorpe contradict, on the testimony of another person, what I have asserted I was an ocular witness of.

I must therefore a second time repeat, that the chesnut woods near Newington, in Kent, are planted in rows at four or five yards distance (other trees often intervening); and for a proof of this fact, I refer Mr. Thorpe to the woods on the North East of the church;

church*; as alſo the wood to the eaſtward of the great road to Canterbury, immediately after you leave the town of Newington.

I ſpent very near a whole day in the examination of theſe woods; but I would more particularly refer to the two cheſnut plantations above ſpecified, as they were juſt then ſhooting from the ſtools, when I took this very minute view of them.

I have already ſaid, that I am willing to leave the point in controverſy, upon what hath been advanced on the one ſide, and on the other.

I will only beg leave to ſtate a ſingle obſervation, together with what ſeems to be an inference that is fairly deducible from it, and which is applicable to any diſputes, with regard to trees being of native growth, or otherwiſe.

I believe I may ſay, that I have been almoſt in every corner of the twelve Welſh counties; and never ſaw a beech tree in any of them, which had the leaſt pretence to be indigenous.

I will ſuppoſe, however, that a wood of any given number of acres, with beech in it, was found in the central part of the principality; and that theſe trees were not planted in rows (as at Newington and Sittingborne); but diſperſed, as happens in other indigenous woods.

Could it poſſibly be contended, that ſuch beech trees had not been introduced by ſome planter; notwithſtanding it might be proved to be a wood of great antiquity?

* I think, I can depend upon my memory ſo far, as to ſay that the cheſnuts I have alluded to, are at the North Eaſt of the church; but at all events, they are very near to it.

If this was inſiſted upon, it muſt at the ſame time be conceived, that when the beech maſt was wafted by the wind to ſuch a moſt ſelected ſpot, ſome preternatural cauſe muſt have prevented its being ſown in any intermediate place.

I am, DEAR SIR,

Your moſt faithful

humble ſervant,

Daines Barrington.

Received November 15, 1770.

XXI. *An Account of the Nyl-ghau, an* Indian *Animal, not hitherto described:* *By* William Hunter, *M. D. F. R. S.*

Read Feb. 28, 1771.

AMONG the riches which, of late years, have been imported from India, may be reckoned a fine animal, the Nyl-ghau; which, it is to be hoped, will now be propagated in this country, so as to become one of the most useful, or at least one of the most ornamental beasts of the field. It is larger than any ruminant of this country, except the ox; its flesh probably will be found to be delicious; and, if it should prove docile enough to be easily trained to labour, its great swiftness, with considerable strength, might be applied, one would think, to valuable purposes.

Good paintings of animals give much clearer ideas than descriptions. Whoever looks at the picture, which was done under my eye, by Mr. Stubbs, that excellent painter of animals (see TAB. V.), can never be at a loss to know the Nyl-ghau, wherever he may happen to meet with it. However, I shall attempt a description of the animal; and then give as much of its history as I have been hitherto able to learn. The account will be imperfect: yet it will give naturalists some pleasure in the mean time to know

know even a little of a large and elegant animal, which has not hitherto been deſcribed, or painted.

At firſt ſight, the male Nyl-ghau ſtruck my imagination with being of a middle nature, between black cattle and deer; ſuch an animal as we might ſuppoſe a mule would be, that was the produce of thoſe two ſpecies of beaſts. In ſize, it is as much ſmaller than the one, as it is larger than the other: and in its form there is a very apparent mixture of reſemblance to both. Its body, horns, and tail, are not unlike thoſe of a bull; and the head, neck, and legs, are very like thoſe of deer.

Colour. The colour, in general, is aſh, or grey, from a mixture of black hairs and white: moſt of the hairs are half white, and half black; the white part is towards the root. The colour of its legs is darker than that of its body; the ſame thing may be ſaid of its head, with this peculiarity, that there the darker colour is not general and uniform, but ſome parts are almoſt quite black. In ſome parts to be mentioned hereafter, the hair is of a beautiful white colour.

Trunk. The height of the back, where there is a ſlight eminence over the ſhoulder-blade, is four feet and one inch; at the higheſt part, immediately behind the loins, it is only four feet. The general length of the trunk, as ſeen in a ſide view, from the root of the neck to the pendulous tail, is about four feet; which is nearly the height of the animal; ſo that, in a ſide view, when it ſtands with its legs parallel, its back and limbs make nearly three ſides

 of

of a ſquare, and the ground upon which it ſtands makes the fourth.

Round the body, immediately behind the ſhoulder, it meaſures four feet and ten inches; and a little more juſt before the hind-legs; but this laſt dimenſion, no doubt, will vary conſiderably, as it happens to be more full or empty of food and drink.

Hair. The hair on the body in general is thinner, more briſtly, and ſtronger, than on our black cattle. On the belly, and upper part of the limbs, it is longer and ſofter than upon the back and ſides.

Mane. All along the ridge or edge of the neck and back, as far as the poſterior part of the hump which is over the ſhoulder-blades, the hair is blacker, longer, and more erect; making a ſhort, and thin, upright mane.

The umbilical and hypogaſtric regions of the belly, the inſide of the thighs, and all thoſe parts which are covered by the tail, are white. The *præputium penis* is not marked with a tuft of hair; and the ſheath of the *penis* projects very little.

Testicles. The teſticles are oblong and pendulous, as in a bull.

Tail. The bones of the tail come down to within two inches of the top of the *os calcis.* The end of the tail is ornamented with long black hair, and likewiſe with ſome white, eſpecially on the inſide. On the inſide of the tail, except near its extremity, there is no hair; and on the right and

left

left there is a border of long white hair, which makes it on the inside look like a feather.

Legs. The legs are small in proportion to their length; more so than in our black cattle, and rather less so than in our deer. The length of the fore-leg is a little more than two feet and seven inches. There is one white spot on the fore part of each foot, almost immediately above the large hoofs; and another smaller white spot before the small hoofs: above each of the small hoofs, there is a remarkable tuft of long white hair, which turns round in a flat curl. The large hoofs of the fore-leg, are of an awkward length. This was very observable in every one of the five individuals of this species which I have seen; yet it was suspected to be the effect of confinement; and the examination of the hoof, in the dead animal, proved that it was so.

Neck. The neck is long and slender, as in deer; and when the head is raised, it has the double turn of the Italic letter *S*. At the throat, there is a shield-like spot of beautiful white hair; and lower down, on the beginning of the convexity of the neck, there is a mane-like tuft of long, black hair.

Head. The head is long and slender. From the horns, it rises upwards and backwards to join the neck. Its length, from the horns only to the point of the nose, is about one feet two inches and three quarters.

Nose.

Nose. The partition between the noſtrils was artificially perforated for fixing a cord, or bridle, according to the Eaſtern cuſtom of tying up or leading horned cattle. The noſtrils are very long, in a direction almoſt parallel to the mouth, and are wideſt at their anterior end.

Mouth. The *rictus oris* is long; and as far as this reaches, the lower jaw is white: ſo is the upper lip, as far as the noſtril.

Teeth. There are ſix grinders in each ſide of each jaw, and four inciſor teeth in each half of the lower jaw. The firſt of the inciſors is very broad; and the reſt ſmaller in gradation, as they are placed more outwards or backwards.

Eyes. The eyes in general are dark coloured; for all of the *conjunctiva* that can be commonly ſeen is of that complexion. In an oblique or ſide view, the *cornea*, and all that is ſeen through it, is blue, like burniſhed ſteel. The pupil is oval, or oblong, from ſide to ſide; and the *iris* is almoſt black.

Ears. The ears are large and beautiful, above ſeven inches in length, and ſpread to a conſiderable breadth near their end. They are white on their edge, and on their inſide; except where two black bands mark the hollow of the ear with a zebra-like variety.

Horns. The horns are ſeven inches long; they are ſix inches round at their root, and growing ſmaller

ſmaller by degrees, they terminate in a blunt point. At their root they have three flattened ſides, divided by ſo many angles: one of the angles is turned forwards, and conſequently one of the ſides backwards. This triangular ſhape is gradually leſs perceptible towards the extremity. At the root there are ſlight circular wrinkles, in proportion to the age of the animal. The body and point of the horn is ſmooth, and the whole of a very dark colour. They riſe upwards, forewards and outwards at a very obtuſe angle, with the forehead or face. They are gently bended, and the concavity is turned inwards, and a little forewards. The diſtance between them at the roots is three inches and a quarter, at the points ſix inches and a quarter, and at their moſt hollow middle parts leſs than ſix inches.

Food. It eats oats, but not greedily; is fonder of graſs and hay *; but is always delighted with wheat bread. When thirſty, it would drink two gallons of water.

Dung. Its dung is in the form of ſmall round balls, of the ſize of a nut-meg; and it paſſes a quantity of theſe together, with a ruſhing ſound.

Manners. Though it was reported to have been exceedingly vicious, it was in reality a moſt gentle creature while in my cuſtody, ſeemed pleaſed with every kind of familiarity, always licked the hand

* General Carnac informs me, that no hay is made in India; their horſes are fed with graſs freſh cut, and a grain of the pulſe kind, called *Gram*.

hand which either ſtroaked, or gave it bread, and never once attempted to uſe its horns offenſively. It ſeemed to have much dependance on it's organs of ſmell, and ſnuffed keenly, and with noiſe, whenever any perſon came within ſight. It did ſo likewiſe when any food or drink was brought to it; and was ſo eaſily offended with a ſmell, or ſo cautious, that it would not taſte the bread which I offered, when my hand had touched oil of turpentine or ſpirits *.

Its manner of fighting is very particular: it was obſerved at Lord Clive's, where two males were put into a little incloſure; and it was related to me by his Lordſhip, thus: While they were at a conſiderable diſtance from each other, they prepared for the attack, by falling down upon their fore-knees; then they ſhuffled towards each other with a quick pace, keeping ſtill upon their fore-knees, and when they were come within ſome yards, they made a ſpring, and darted againſt each other.

All the time that two of them were in my ſtable, I obſerved this particularity, *viz.* that whenever any attempt was made upon them, they immediately fell down upon their fore-knees; and ſometimes they

* General Carnac, in ſome obſervations which he favoured me with upon this ſubject, ſays, "All of the deer kind have "the ſenſe of ſmelling very exquiſite. I have frequently ob- "ſerved of tame deer, to whom bread is often given, and "which they are in general fond of, that if you preſent them "a piece that has been bitten, they will not touch it. I have "made the ſame obſervation of a remarkable fine ſhe-goat, "which accompanied me moſt of my campaigns in India; and "ſupplied me with milk, and which, in gratitude for her ſer- "vices, I brought from abroad with me."

would

would do ſo when I came before them; but, as they never darted, I ſo little thought this poſture meant hoſtility, that I rather ſuppoſed it expreſſive of a timid or obſequious humility *.

FEMALE. The *Female* differs ſo much from the *Male*, that we ſhould ſcarcely ſuppoſe them to be the ſame ſpecies. She is much ſmaller, both in height and thickneſs. In her ſhape, and in her yellowiſh colour, ſhe very much reſembles deer; and has no horns. She has four nipples, and is ſuppoſed to go nine months with young. She commonly has one at a birth, and ſometimes twins.

The young male Nyl-ghau is like the female in colour, and therefore like a Fawn.

SPECIES. When a new animal is preſented to us, it will often be difficult, and ſometimes impoſſible, to determine its ſpecies, by the external characters alone. But when ſuch an animal is diſſected by an anatomiſt, who is a maſter in comparative

* The intrepidity and force with which they dart againſt any object may be conceived from the following anecdote, of the fineſt and largeſt of thoſe animals that has ever been ſeen in England. The violence which he did to himſelf, was ſuppoſed to occaſion his death, which happened ſoon after. A poor labouring man, without knowing that the animal was near him, and therefore neither meaning to offend, nor ſuſpecting the danger, came up near to the outſide of the pales of the incloſure; the Nyl-ghau, with the quickneſs of lightening, darted againſt the wood work, with ſuch violence, that he broke it to pieces; and broke off one of his horns cloſe to the root. From this piece of hiſtory and farther inquiry, I was ſatisfied that the animal is vicious and fierce in the rutting ſeaſon, however gentle and tame at other times.

anatomy, the queſtion is commonly to be decided with certainty.

From the external marks alone, I ſuſpected, or rather believed, the Nyl-ghau to be a peculiar and diſtinct ſpecies. Some of my acquaintance thought it a deer. The permanent horns convinced me that it was not. Others thought it an antelope. The horns, and the ſize of the animal, made me ſuſpect that it was not. It had ſo much of the ſhape of deer, eſpecially the female, that I could not ſuppoſe it to be of the ſame ſpecies with our black cattle. In rutting time, one of the males was put into a paddock with a female of the red-deer: but nothing like attraction or attention was obſerved between them. At length, in conſequence of the death of one of them, I was aſſured by my brother, who diſſected it, and who has diſſected with great attention almoſt every known quadrupede, that the Nyl-ghau, is a new ſpecies *.

HISTORY. Of late years ſeveral of this ſpecies, both male and female, have been brought to England. The firſt were ſent from Bombay, by Gov. Cromelen, as a preſent to Lord Clive: they arrived in Auguſt 1767. They were male and female, and continue to breed every year. Afterwards two were brought over, and preſented to the Queen by Mr. Sullivan. From her Majeſty's deſire to encourage every uſeful or curious enquiry in natural knowledge,

* Mr. Pennant, whoſe love of natural hiſtory heightens the enjoyment of an independent fortune, in his *Synopſis*, publiſhed ſince this paper was written, claſſes this animal (*White-footed*, p. 29.) as a ſpecies of the *Antelope*; but he now thinks it belongs to another *Genus*, and will claſs it accordingly in his next edition.

I was

I was permitted to keep these two for some time; which enabled me to describe them, and to get a correct picture made; and, with my brother's assistance to dissect the dead animal, and preserve the skin and skeleton. Lord Clive has been so kind to give me every help that he could furnish me with, in making out their history; so has General Carnac, and some other gentlemen.

At all the places in India, where we have settlements, they are rarities, brought from the distant interior parts of the country, as presents to Nabobs and great men. Lord Clive, General Carnac, Mr. Walsh, Mr. Watts, and many other gentlemen, who have seen much of India, tell me they never saw them wild. So far as I have yet found, Bernier is the only author who has even mentioned them *. In the 4th Vol. of his Memoires, he gives an account of a journey which he undertook, ann. 1664, from Delhi, to the province of Cachemire, with the Mogul Aurengzeb, who went to that terrestrial paradise, as it is esteemed by the Indians, to avoid the heat of the summer. In giving an account of the hunting, which was the Emperor's amusement in this journey, he describes, among others, that of *le Nylghau*; but without saying more of the animal, than

* Since the reading of this paper, I have received the following information from Dr. Maty. In the fourth Volume of Valentyn's description of the East Indies, published in Low Dutch, 1727, under the article of Batavia, p. 231, I find amongst the uncommon animals kept at the castle, this short indication, "There was a beast, of the size and colour of a "Danish ox, but less heavy, pointed towards the mouth, ash-"grey, and not less than an Elk, whose name he bore." It was a present from the Mogul.

that the Emperor ſometimes kills them in ſuch numbers, as to diſtribute quarters of them to all his Omrachs; which ſhews that they were there wild, and in plenty, and eſteemed good or delicious food.

This agrees with the rarity of theſe animals at Bengal, Madraſs, and Bombay: for Cachemire is the moſt northern province of the Empire; and it was on the march from Delhi to that place, that Bernier ſaw the Emperor hunt them.

NAME. The word *Nyl-ghau*, for theſe are the component letters correſponding to the Perſian, though pronounced as if it were written *Neel-gaw*, ſignifies a blue cow, or rather a bull, *Gaw* being maſculine; and the male animal of that name has a good title to the appellation, as well from the likeneſs he bears in ſome parts to that ſpecies of cattle; as from the bluiſh tinct which is very diſcernible in the colour of his body; but this is by no means the caſe with the female, which has a near reſemblance, as well in colour as in form, to our red deer. The Nyl-ghaus which have been brought to England have been moſt, if not all, of them received from Surat or Bombay; and they ſeem to be leſs uncommon in that part of India, than in Bengal; which gives room for a conjecture that they may be indigenous perhaps in the province of Guzarat, one of the moſt Weſtern and moſt conſiderable of the Hinduſtan empire, lying to the Northward of Surat, and ſtretching away to the Indian ocean.

A gentleman * who has been long in India, and has an extenſive acquaintance there, has written to

* General Carnac, who likewiſe favoured me with the preceding article upon the name of the animal.

his

his friends, to collect all the intelligence they can possibly procure concerning this animal; and in the course of the next year, some satisfactory information may perhaps be received from thence, though the natives of that country, he says, have no turn whatever after natural history; and indeed are very little inquisitive after any kind of knowledge.

XXII. *Obſervations on the* Aphides *of* Linnæus, *by Dr.* William Richardſon, *of* Ripon, Yorkſhire: *Communicated by* William Heberden, *M. D. F. R. S.*

Read Mar. 14, 1771.

THE learned *Linnæus* by his unwearied application having reduced the various productions of nature into one regular ſyſtem, and clearly diſtinguiſhed the numerous tribe of inſects into their diſtinct claſſes and ſubdiviſions, ſeems to me to have laid a more ſolid foundation for the natural hiſtory of theſe minute animals, than any other writer who has gone before him. Difficult, however, as it is to lay ſo firm a foundation, the ſuperſtructure muſt ſtill be eſteemed a more arduous undertaking; as it is eaſier to diſtinguiſh the outward form, even of the minuteſt inſects, than to diſcover their internal nature and diſpoſition. This is a knowledge not to be attained by any ſingle perſon, be his genius and diligence ever ſo great; but to bring it to any degree of perfection, will require the joint endeavours of the curious in all ages, and in all the different parts of the world. From which conſiderations, I am induced to throw in my mite towards promoting ſo uſeful an undertaking; by reducing my obſervations on this ſurprizing kind of inſect, into a more conciſe and regular form.

Though the Aphides are diſtinguiſhed by Linnæus into more than thirty ſpecies; ſtill I am ſatisfied, from my own obſervation, the diſtinct ſpecies are even double that number: nor can I altogether agree with this ingenious author, that there are a greater variety of plants producing Aphides, than there are different ſorts of this inſect. Where plants are of a like nature, they are uſually frequented by the ſame inſects; but many of theſe plants will be found to ſupport two or more quite different ſorts. On the peach and nectarine indeed the Aphides are the ſame, nor do I find on theſe trees more than one ſort. The plum tree, on the other hand, has two ſorts, very diſtinct from each other: one of a yellowiſh-green, with a round ſhort body; the other of a bluiſh-green, as it were enameled with white, and the ſhape more oblong. On the gooſberry-buſh and currant the ſame Aphides may be found; but each of theſe is inhabited by two very different ſpecies: one being of a duſky green, with a ſhort plump body; the other of a paler green, the body more taper, and tranſverſly wrinkled. To theſe inſtances I muſt further add, that the roſe-tree ſupports not leſs than three diſtinct ſpecies: The largeſt of which is of a deep green, having long legs of a browniſh caſt, with the joints of a very dark brown, as are alſo the horns and antennæ; a ſecond ſort is paler green, has much ſhorter legs, and a more flat body; the third ſort is of a pale red, its body tranſverſly wrinkled, and is moſt frequently on the ſweet-brier. It not being, however, ſo much my intention to enumerate the different ſpecies of theſe inſects, as to give ſome inſight into their extraordi-

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nary nature; the inſtances I have already produced will, I flatter myſelf, be thought ſufficient.

The great variety of ſpecies which occur in the inſects now under conſideration may indeed make an enquiry into their particular natures ſeem not a little intricate and perplexed; having them, however, ſkilfully reduced under their proper genus, the difficulty is by this means conſiderably diminiſhed. All the inſects comprehended under any diſtinct genus, we may reaſonably ſuppoſe to partake of one general nature; and, by diligently examining any of the particular ſpecies, may thence gain ſome inſight into the nature of all the reſt. With this view I have choſen, out of the various ſorts of Aphides, the largeſt of thoſe found on the roſe tree; not only as its ſize makes it the more conſpicuous, but as there are few others of ſo long a duration. This ſort, appearing early in the ſpring, continues late in the autumn; while ſeveral are limited to a much ſhorter term, in conformity to the different trees and plants from whence they drew their nouriſhment.

SECTION I.

If at the beginning of February the weather happens to be ſo warm, as to make the buds of the roſe tree ſwell and appear green; ſmall aphides are frequently to be found upon them, not larger than the young ones in ſummer, when firſt produced. But there being no old ones to be found at this time of the year, which in ſummer I had obſerved to be viviparous; I was formerly not a little perplexed by ſuch

ſuch different appearances, and almoſt induced to give credit to the old doctrine of equivocal generation. That ſhe ſame kind of animal ſhould, at one time of the year be viviparous, and at another oviparous, was an opinion I could then by no means entertain. This, however, frequent obſervation has at laſt convinced me to be fact; having found thoſe Aphides, which appear early in the ſpring, to proceed from ſmall black oval eggs, which were depoſited on the laſt year's ſhoots in autumn: though, when it happens that thoſe inſects make too early an appearance, I have obſerved the greateſt part to ſuffer from the ſharp weather that uſually ſucceeds; by which means the roſe trees are ſome years in a manner freed from them.

Thoſe which withſtand the ſeverity of the weather, ſeldom come to their full growth before the month of April; at which time they uſually begin to breed, after twice caſting off their exuviæ, or outward-covering. It then appears that they are all females, which produce each of them a very numerous progeny, and that without having intercourſe with any male inſect. As I obſerved before, they are viviparous; and what is equally uncommon, the young ones all come into the world backwards. When they firſt come from the parent, they are enveloped by a thin membrane, having in this ſituation the appearnce of an oval egg; which I apprehend muſt have induced Reaumur to ſuſpect that the eggs diſcovered by Bennet were norhing more than abortions. This egg-like appearance adheres by one extremity to the mother, while the young one therein contained extends the other; by that means

means gradually drawing the ruptured membrane, over the head and body, to the hind feet. During this operation, and for ſome time after, by means of ſomething glutinous, the fore part of the head adheres to the vent of the parent. Being thus ſuſpended in the air, it ſoon frees itſelf from the membrane in which it was confined, and after its limbs are a little ſtrengthened, is ſet down on ſome tender ſhoot, and then left to provide for itſelf.

When the ſpring proves mild, and conſequently favourable to this kind of inſect, I have obſerved not only the roſe trees, but various kinds of fruit-trees, to be greatly injured by them. Hence I was firſt introduced to inveſtigate the nature of theſe inſects; in order to find out ſome expedient, whereby ſo great an evil might be prevented. To avoid being tedious by deſcending to particulars, I ſhall recommend the following general rule; *viz.* to lop off the infected ſhoots before theſe inſects are greatly multiplied; repeating the ſame operation before the time their eggs are depoſited. By the firſt pruning, you will prevent a very numerous preſent increaſe; and by the ſecond, may intirely cut off the next year's ſupply.

SECTION II.

In the ſpring months, there appear on the roſe tree but two generations of Aphides, including thoſe which immediately proceed from the laſt year's eggs; the warmth of the ſummer adds ſo much to their fertility, that no leſs than five generations ſucceed each other during that interval. One is produced

duced in May, which twice caſts off its covering; while the months of June and July each ſupply two more, which caſt off their coverings three or four times, according to the different warmth of the ſeaſon. This frequent change of the outward covering is the more extraordinary, as it is the ofteneſt repeated when the inſects come the ſooneſt to their growth; which I have ſometimes obſerved to happen in ten days, where warmth and plenty of nouriſhment have mutually conſpired. From which conſiderations, I am thoroughly convinced, that theſe various coverings are not connate with the inſect; but that they are like, the ſcarf-ſkin, ſucceſſively produced.

Early in the month of June, ſome of the third generation, which were produced about the middle of May, after caſting off their laſt covering, diſcover four erect wings, much longer than their bodies: and the ſame is obſervable in all the ſuceeding generations, which are produced during the ſummer months; without however diſtinguiſhing any diverſity of ſex, as is uſual in ſeveral other kinds of inſects. For ſome time before the Aphides come to their full growth, it is eaſy to diſcover which of them will have wings, by a remarkable fulneſs in the breaſt, which in the others is hardly to be diſtinguiſhed from the body. When the laſt covering is rejected, the wings, which were before folded up in a very narrow compaſs, gradually extend themſelves in a moſt ſurprizing manner, till their dimenſions are at laſt very conſiderable. But theſe winged ones have this further peculiarity, that the number of them does not ſeem ſo much to depend on their

 original

original ſtructure, as on the quantity or quality of the nouriſhment wherewith they are ſupplied: it being frequently obſervable, that thoſe on a ſucculent ſhoot have few or none with wings among them; while others of the ſame generation, on a leſs tender branch, are moſt of them winged: as if the firſt rudiments of the wings were compoſed in the former, while nature thought proper to expand them in the latter, that they might be more at liberty to ſupply their wants.

The increaſe of theſe inſects in the ſummer time is ſo very great, that, by wounding and exhauſting the tender ſhoots, they would frequently ſuppreſs all vegetation, had they not many enemies which reſtrain them. To enumerate the variety of other inſects, that in their worm and fly ſtate are conſtantly deſtroying them, would exceed the bounds of my preſent deſign: there is one, however, ſo ſingular in the manner of executing its purpoſe, that I cannot paſs it by without ſome further notice. This is a very ſmall black ichneumon fly, with a ſlender body, and very long antennæ; which darts its pointed tail into the bodies of the Aphides, at the ſame time depoſiting an egg in each. This egg produces a worm, which feeds upon the containing inſect, till it has acquired its full growth; when it is uſually changed to that kind of fly from whence it had its origin. In this, however, it is ſometimes prevented by another ſort of ſmall black fly, which wounds this worm through its pearl-like habitation; and by laying one of its eggs therein, inſtead of the former fly, produces its own likeneſs.

I muſt however further obſerve, notwithſtanding theſe inſects have many enemies, they are not without friends; if we may conſider thoſe as ſuch, who are very officious in their attendance, for the good things they expect to reap thereby. The ant and the bee are both of this kind, collecting the honey in which the Aphides abound; but with this difference, that the ants are conſtant viſitors, the bee only when flowers are ſcarce. To which let me alſo add, that the ants will ſuck in the delicious nectar, while the Aphides are in the act of diſcharging it from the anus; but the bees only collect it from the leaves, on which this honey-dew has fallen.

SECTION III.

In the autumn, I find three more generations of Aphides to be produced; two of which make their appearance in the month of Auguſt, and the third uſually before the middle of September. As the two firſt differ in no reſpect from thoſe which we meet with in ſummer, it would be waſting time to dwell any longer upon them; but the third, differing greatly from all the reſt, demands our giving it a more ſerious attention. Though all the Aphides which have hitherto appeared were females, in this tenth generation are found ſeveral male inſects; not that they are by any means ſo numerous as the females, being only produced by a ſmall part of the former generation. To which I muſt further add, that I have obſerved thoſe which produce males, previouſly to have produced a number of females; which in all reſpects reſembling thoſe already deſcribed,

ſcribed, I ſhall decline taking into any further conſideration.

The females have at firſt altogether the ſame appearance with thoſe of the former generations; but in a few days their colour changes from a green to a yellow, which is gradually converted into an orange-colour, before they come to their full growth. They differ likewiſe in another reſpect, at leaſt from thoſe which occur in the ſummer, that all thoſe yellow females are without wings. The male inſects are however ſtill more remarkable; their outward appearance readily diſtinguiſhing them, from the females of this and all other generations. When firſt produced, they are not of a green colour like the reſt, but of a reddiſh brown; and have afterwards, when they begin to thicken about the breaſt, a dark line along the middle of the back. Theſe male inſects come to their full growth in about three weeks time, and then caſt off their laſt covering; the whole inſect being after this operation of a bright yellow, the wings only excepted. But they ſoon change to a darker yellow, and in a few hours to a very dark brown; if we except the body, which is ſomething lighter coloured, and has a reddiſh caſt. They are all of the winged ſort; and the wings, which are white at firſt, ſoon become tranſparent, and at length appear like very fine black gauze.

The males no ſooner come to maturity, than they copulate with the females; in which act they are readily diſcovered, as they remain in conjunction for a conſiderable time, and are not eaſily diſturbed. The commerce between them continues the whole month of October, and may be obſerved at all times

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of the day; though I have found it moſt frequent about noon, eſpecially when the weather is moderately warm, with the ſun overcaſt. The females, in a day or two after their intercourſe with the males, I have obſerved to lay their eggs; which they uſually do near the buds, when they are left to their own choice. Where there are a number crowded together, they of courſe interfere with each other; in which caſe, they will frequently depoſit their eggs on other parts of the branches, or even on the ſpines with which they are beſet. I do not however find that the eggs produced by theſe inſects bear any proportion to the number of young ones which proceed from the females of other generations; not having obſerved any one inſect to produce more than two or three, and that in appearance with great difficulty.

Having now traced their progreſs through the different ſeaſons of the year, and obſerved the various metamorphoſes which they ſucceſſively undergo; I cannot help ſuſpecting the inſufficiency of human reaſon, in ſetting any ſcheme to which the different changes of inſects may be accurately reduced. Though the indefatigable Swammerdam ſeems to have been fully convinced that there is no inſect, whoſe changes may not be reduced to one or other of the four orders he has deſcribed; ſtill the inſect now under conſideration, having at different ſeaſons quite different appearances, cannot, I think, with ſtrictneſs be confined to any of them. In the ſpring they ſeem in ſome meaſure to coincide with the firſt order, though in ſummer thoſe with wings more properly belong to the ſecond; but in

autumn,

autumn, the males may ſeem to come under one order, and the females under another; or, I ſhould rather think theſe inſects are not clearly reducible to any order.

SECTION IV.

Some of the inſects now under conſideration continuing to lay their eggs till the beginning of November, I chooſe to defer giving a more particular account of them, till the ſeaſon for which they ſeem by nature to have been deſigned. Theſe eggs are of a regular oval figure, being about the tenth part of an inch in length, and the twentieth in breadth; which, though it may ſeem a very inconſiderable bulk, is certainly large for ſo minute an inſect. When they are firſt produced, their colour is green, but in a few days turns to brown, and by degrees becomes quite black. The covering of the eggs may be called thick, if compared with its ſmall ſize; which at firſt is rather of a yielding nature; but, after being expoſed to the air, ſoon contracts a greater firmneſs. If this covering is wounded, there iſſues forth a mucilaginous fluid, which is very tranſparent, and in appearance of a uniform conſiſtence. Theſe eggs adhere firmly to the branches on which they are depoſited, by means of ſomething glutinous wherewith they are beſmeared, and in a moſt ſurprizing manner reſiſt all the ſeverity of the winter.

Though I have juſt now obſerved, the contents of the eggs to have the appearance of an uniform fluid; that this cannot in reality be the caſe, ſufficiently appears from the Aphides they produce in the

the ſpring, without any other aid than the warmth of the ſeaſon. Nor is a ſingle inſect to be eſteemed the whole product of an egg, ſince it has been clearly ſhewn, that ten generations ſucceed each other; the firſt rudiments of which muſt have been originally in the egg, as the females have no communication with the males but in autumn. The wonder however becomes ſtill greater, when we conſider the number of individuals in each generation; this being, I am fully convinced, at a medium, not leſs than fifty. Whoever pleaſes to multiply by fifty, nine times over, may by this means form ſome notion of the great number of inſects produced from a ſingle egg; but will at the ſame time find that number ſo immenſe, as to exceed all comprehenſion, and indeed to be little ſhort of infinity. How far this can be reconciled with any theory of generation which the ingenuity of man has hitherto invented, may be a contemplation not altogether unworthy our curioſity, though I fear it will not turn out much to the credit of our reaſoning faculties.

The ancient doctrine of equivocal generation, as alſo that from an admixtion of the ſeminal matter of both ſexes, being now quite rejected by all modern naturaliſts; two other opinions ſeem to have ſprung up in their ſtead. While one party aſſerts, that the original organization of the fœtus exiſts in the ovary of the female, and that it is vivified by a ſubtile ſpirit in the ſpermatic fluid of the male; the other lays it down for a certainty, that the eggs of the female are only to be conſidered as a proper nidus, provided for the reception of thoſe minute animalcules, with which the male ſemen is found to

 abound

abound. As the former opinion does not appear to have any certain fact to support it, we may well suspect an insufficiency in the cause to produce the effect assigned; but, supposing it adequate to the production of one generation, who can conceive a subtile spirit to remain in force for ten generations, and that through all the various seasons of the year? With regard to the latter, I must observe, that the animalcules of Leeuwenhock being compared with Malpighi's first rudiments of the chick, their resemblance is not so striking as to afford me the least conviction: but should we allow these animalcules requisite to produce the first generation, how then are the subsequent nine generations produced without them? Not being able to answer these queries myself, nor expecting them to be readily answered by others; it seems most prudent to observe with diligence what nature does, without being over anxious to discover by what means. Let us rest satisfied in admiring the wonderful effects of generation, while we refer the primary efficient cause to the eternal will and power of an Almighty Creator.

Read March 21, 1771.

XXIII. *Meteorological Observations at* Ludgvan *in* Mount's-Bay, Cornwall, 1770: *By* William Borlase, *D. D. F. R. S. Communicated by Dr.* Jeremiah Milles, *Dean of* Exeter, *and F. R. S.*

Month.	Barometer.	State of the Weather and Wind.	Fahrenheit's Thermom.			Ombr.
					Med.	Inches.
January	Higheſt 28 30,51 Very high Loweſt 7 29,36	Snow from the 5th to the 9th; 10th, ſnow all gone. Violent ſtorm on the 11th; nine days calm; reſt miſty, with fogs, ſhowers, and wind. Eaſt and Weſt winds nearly equal, latter rather more; hard froſt on the 7th day only.	Higheſt 2 Loweſt 7	51 32	$43\frac{18}{31}$	$3\frac{160}{1000}$
February	Higheſt 14 30,39 Loweſt 18 29,1	Calm 12 days; a violent ſtorm all night the 18th; a ſlight froſt only on the 24th; wind Weſterly 21 days.	Higheſt 14 Loweſt 24	51 36	$44\frac{3}{28}$	3,300
March	Higheſt 2 30,6 Loweſt 10 28,71	Sleet, deep ſnow and lying, the 16th, 17th, 18th, 19th, 20th, with hard froſt; froſt, and hard ſnowing and windy, 23d, 24th; ſnow, hail, and froſt, 26th, 27th, 28th, 29th. Froſt and ſnow gone the 30th, with hazy miſts. Wind moſtly from the North and Eaſt, being to the Weſt as 19 to 12.	Higheſt 31 Loweſt 21	$51\frac{1}{2}$ 32	$41\frac{5}{31}$	4,040
April	Higheſt 29 30,31 Loweſt 6 28,90	Mixture of all weathers, but that of froſt and ſnow we had none. Wind 22 days from the North; reſt nearly equal.	Higheſt 30 Loweſt 9	54 39	46	3,400

May

Month.	Barometer.	State of the Weather and Wind.	Fahrenheit's Thermom.	Ombr.
			Med.	Inches.
May	Higheſt 1 29,98 Loweſt 5 28,99	Firſt 7 days windy and ſtormy ſhowers; in the reſt 20 days of calm, moſtly fair. Wind 16 days from the Eaſt equally mixed with North and South.	Higheſt 28 60 Loweſt 3 $40\frac{1}{2}$ } $52\frac{1}{31}$	3,000
June	Higheſt 14 30,7 Loweſt 19 29,17	Moſtly hazy and miſty. Fair, windy, rain and cloudy, nearly equal. Wind 26 days from the Weſt, chiefly mixed with the South.	Higheſt 9 61 Loweſt 20 49 } $54\frac{29}{30}$	3,200
July	Higheſt 12 30,20 Loweſt 18 29,32	Calm 24 days, ſome hazy and miſty, but little or no rain. Wind Weſterly 22 days, its mixture moſtly with the South.	Higheſt 13 66 Loweſt 4 52 } $58\frac{6}{31}$	1,950
Auguſt	Higheſt 4 30,10 Loweſt 20 29,62	18 calm days; reſt miſty, hazy, or fair. On the 6th at 8 P. M. much lightning; violent about a quarter paſt 9, with very rapid flaſhes, and loud thunder, till two A. M. when it began to rain with a violent flood for a quarter of an hour; afterwards, much rain, but no more thunder or lightning. Wedneſday the 8th, cloſe calm morning; about five A. M. thunder, with much lightning; about ſix rained violently, at nine cleared off, and a fair day. Thurſday morning the 9th, 2 A. M. lightning and thunder, but not ſo violent; wind Eaſterly; wind Eaſt and Weſt nearly equal, with North and South nearly equal.	Higheſt 6 71 Loweſt 31 55 } $60\frac{1}{31}$	1,850
September	Higheſt 28 30,10 Loweſt 26 28,84	Weather moſtly variable, and of all kinds. On the 18th hazy and calm, A. M.; P. M. a ſtorm and hard rain; on the 25th and 26th a continued ſtorm to the 27th; the 28th calm with miſts; wind twenty-five days South, with a greater mixture of the Weſt.	Higheſt 6 63 Loweſt 22 53 } $58\frac{1}{2}$	2,840

October

Month.	Barometer.	State of the Weather and Wind.	Fahrenheit's Thermom.	Med.	Ombr. Inches.
October	Higheſt 7 30,24 Loweſt 22 28,69	Firſt eleven days calm and mild; next twelve days violent rains and windy; next eight days ſhowery, and rains. Wind twenty-five days Weſterly, with eighteen days mixture of the North; reſt equal.	Higheſt 1 60 Loweſt 22 43	$50\frac{20}{31}$	6,550 at leaſt, the receiver being brim-full when looked to: whether overflowed uncertain.
November	Higheſt 4 29,94 Loweſt 8 28.44 Very low here.	Rain twenty-two days; reſt ſtormy, windy, and cloudy. Wind Weſterly twenty-ſix days; mixed moſtly with the South. An extraordinary fall of rain this month; on the 25th a ſtorm all night.	Higheſt 3 53 Loweſt 20 37	$47\frac{1}{30}$	7,250
December	Higheſt 1 30,0 Loweſt 23 29,20	26 days rain and ſhowers; much ſtormy weather. On the 18th in the evening, began a violent ſtorm from Weſt, and W. S. W.; the extreme was at eleven P. M. Wind twenty-ſix days blew from the Weſt; moſtly mixed with the South.	Higheſt 15 52 Loweſt 25 37	$45\frac{30}{31}$	4,100

Total Rain this Year 1770, at leaſt $44,\frac{640}{1000}$

XXIV. *Deſcription*

XXIV. *Description of a new Hygrometer:* *By Mr.* John Smeaton, *F. R. S.*

Read March 21, 1771.

HAVING some years ago attempted to make an accurate and sensible hygrometer, by means of a hempen cord, of a very considerable length; I quickly found, that, though it was more than sufficiently susceptible of every change in the humidity of the atmosphere, yet the cord was, upon the whole, in a continual state of lengthening. Though this change was the greatest at first, yet it did not appear probable that any given time would bring it to a certainty; and futhermore it seemed, that, as the cord grew more determinate in mean length, the alteration by certain differences of moisture grew less. Now as, on considering wood, paper, catgut, &c. there did not appear to be a likelihood of finding any substance sufficiently sensible of differences of moisture, that would be unalterable under the same degrees thereof; this led me to consider of a construction which would readily admit of an adjustment; so that, though the cord whereby the instrument is actuated may be variable in itself, both as to absolute length, and difference of length under given degrees of moisture, yet that, on supposition of a material departure from its original scale, it might be readily restored

ſtored thereto, and in conſequence that any numbers of hygrometers, ſimilarly conſtructed, might, like thermometers, be capable of ſpeaking the ſame language.

The two points of heat, the more readily determinable in a thermometer, are the points of freezing and boiling water. In like manner, to conſtruct hygrometers which ſhall be capable of agreement, it is neceſſary to eſtabliſh two different degrees of a moiſture which ſhall be as fixed in themſelves, and to which we can as readily and as often have recourſe as poſſible. One point is given by making the ſubſtance perfectly wet, which ſeems ſufficiently determinable; the other is that of perfect dry; but which I do not apprehend to be attainable with the ſame preciſion. A readineſs to imbibe wet, ſo that the ſubſtance may be ſoon and fully ſaturated, and alſo a facility of parting with its moiſture, on being expoſed to the fire to dry; at the ſame time that neither immerſion in water, nor a moderate expoſition to the warmth of the fire, ſhall injure its texture; are properties requiſite to the firſt mover of ſuch an hygrometer, that in a manner exclude all ſubſtances that I am acquainted with, beſides hempen and flaxen threads or cords, and what are compounded thereof.

Upon theſe ideas, in the year 1758 I conſtructed two hygrometers, as near alike as poſſible, in order that I might have the means of examining their agreement or diſagreement on ſimilar or diſſimilar treatment. The interval or ſcale between dry and wet, I divided into 100 equal parts, which I call the degrees of this hygrometer. The point of 0 denotes

denotes perfect dry; and the numbers increase with the degrees of moisture to 100, which denotes perfect wet.

On comparing them for some time, when hung up near together in a passage or stair-case, where they would be very little affected by fire, and where they would be exposed to as free an air as possible in the inside of the house, I found that they generally were within one degree, and very rarely differed two degrees; but, as these comparisons necessarily took up some time, and were frequently interrupted by long avocations from home, it was some years before I could form a tolerable judgement upon them. One thing I soon observed, not altogether to my liking; which was, that the flaxen cords, which I made use of, seemed to make so much resistance to the entry of small degrees of moisture (such as is commonly experienced within doors in the situation above-mentioned) that all the changes were comprized within the first 30 degrees of the scale; but yet, on exposing them to the warm steam of a wash-house, the index quickly mounted to 100. I was therefore desirous of impregnating the cords with something of a saline nature, which should dispose them more forcibly to attract moisture; in order, that the index might, with the ordinary changes of moisture in the atmosphere, travel over a greater part of the scale of 100: how to do this in a regular and fixed quantity, was the subject of many experiments, and several years interrupted enquiry. At last, I tried the one here- after described, which seemed to answer my intentions in a great measure; and though, upon the whole, it does not ap-

pear

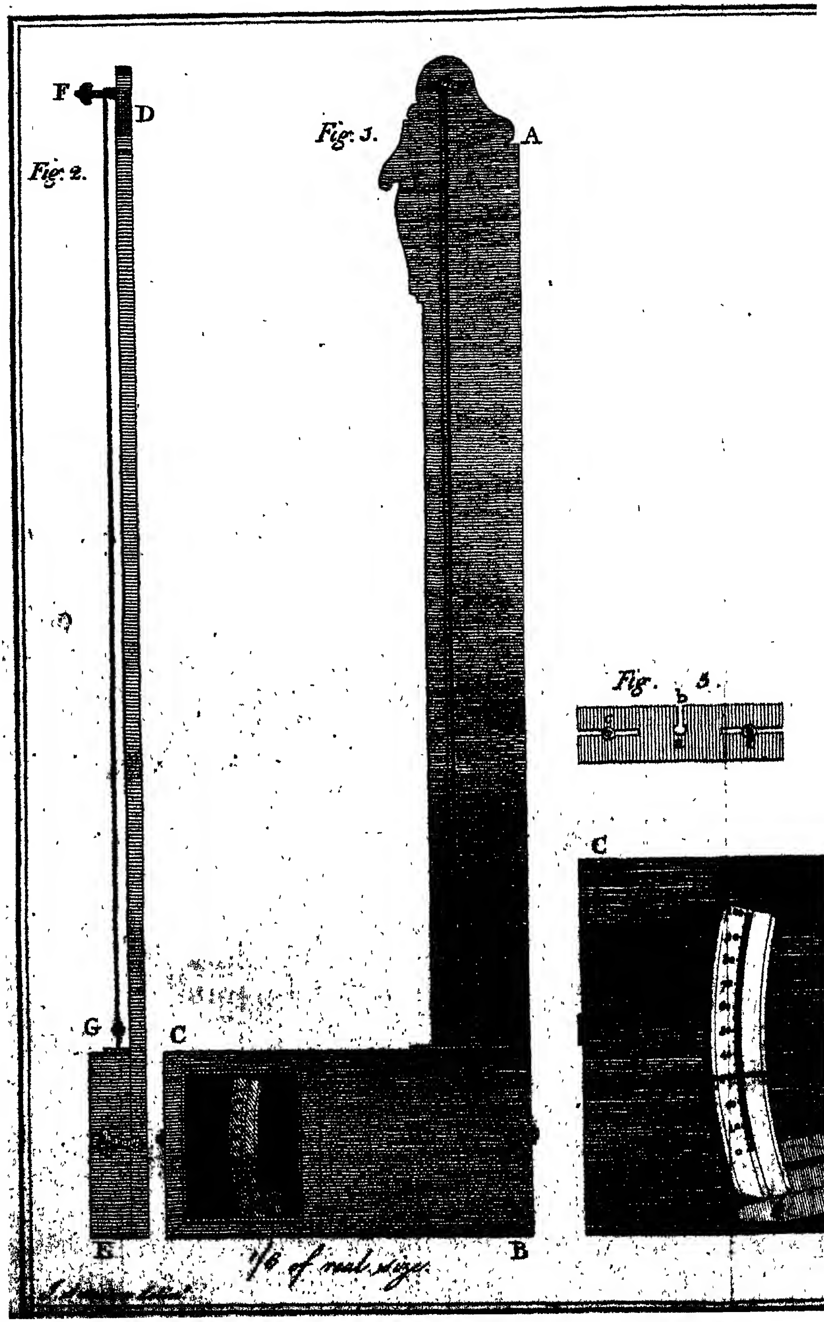


Fig. 2.
F
D
G
E
Fig. 3.
A
C
B
Fig. 5.
b
C
1/6 of real size

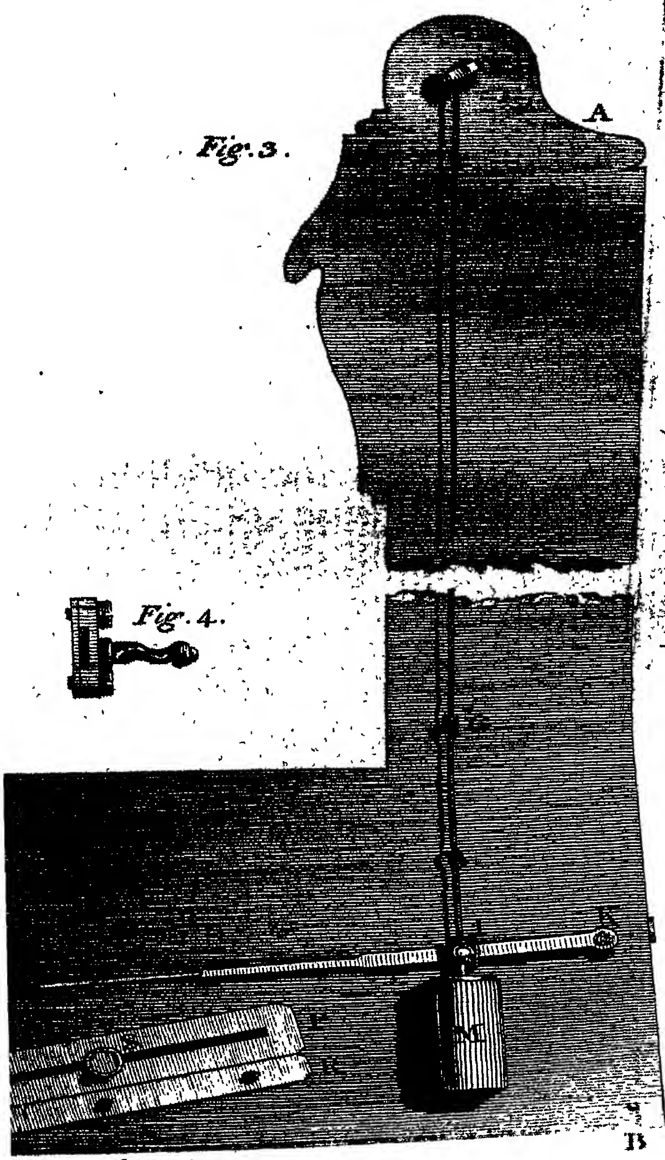


Fig. 3.

Fig. 4.

1/3 of real size

Basire sc.

pear likely that this inſtrument will ever be made capable of ſo accurate an agreement, as mercurial thermometers are made to be; yet, if we can reduce all the diſagreements of an hygrometer within $\frac{1}{40}$th part of the whole ſcale, it will probably be of uſe in ſome philoſophical enquiries, in lieu of inſtruments which have not as yet been reduced to any common ſcale at all.

Deſcription of the Hygrometer.

Fig. 1 and 2, A B C is an orthographick delineation of the whole inſtrument ſeen in front in its true proportion.

D E is that of the profile, or the inſtrument ſeen edgeways.

F G, in both, repreſents a flaxen cord, about 35 inches long, ſuſpended by a turning peg F, and attached to a loop of braſs wire at A, which goes down into the box cover H, which defends the index, &c. from injury, and by a glaſs expoſes the ſcale to view.

Fig. 3. ſhews the inſtrument to a larger ſcale, the upright part being ſhortened, and the box cover removed; in which the ſame letters repreſent the ſame parts as in the preceeding figures; G I are two loops or long links of braſs wire, which lay hold of the index K L, moveable upon a ſmall ſtudd or center K. The cord F G is kept moderately ſtrained by a weight M, of about half a pound avoirdupoize.

It is obvious, that as the cord lengthens and ſhortens, the extreme end of the index riſes and falls, and ſucceſſively paſſes over

N 2 the ſcale, diſpoſed in the arch of a circle, and containing 100 equal diviſions. This ſcale is attached to the braſs ſliding ruler Q P, which moves upon the directing piece R R, fixed by ſcrews to the board, which makes the frame or baſe of the whole; and the ſcale and ruler, N Q P, is retained in any place, nearer to or further from the center K, as may be required, by the ſcrew S.

Fig. 4. repreſents in profile, the ſliding piece, and ſtudd I. (fig. 3.), which traverſes upon that part of the index next the center K; and which can, by the two ſcrews of the ſtudd, be retained upon any part of the index that is made parallel; and which is done for 3 or 4 inches from the center, for that purpoſe. The ſtudd is filed to the edges, like the fulcrum of a ſcale beam, one being formed on the underſide, the other upon the upper, and as near as may be to one another. An hook formed at the lower end of the wire loops C I, retains the index by the lowermoſt edge of the ſtudd, while the weight M hangs by a ſmall hook upon the upper edge: by theſe means the index is kept ſteady, and the cords ſtrained by the weight, with very little friction or burthen upon the central ſtudd K.

Fig. 5. is a parallelogram of plate braſs, to keep out duſt, which is attached to the upper edge of the box cover H, and ſerves to ſhut the part of the box cover neceſſarily cut away, to give leave for the wire G I to traverſe with the ſliding ſtudd (fig. 4.) nearer to, or further from, the center of the index K; and where in (fig. 5.) *a* is an hole about $\frac{1}{4}$ of an inch diameter, for the wire G I to paſs through, in the riſing and falling of the index, freely

freely without touching; *b* is a ſlit of a leſſer ſize, ſufficient to paſs the wire, and admit the cover to come off without deranging the cord or index; *c c* are two ſmall ſcrews applied to two ſlits, by which the plate ſlides lengthways, in order to adapt the hole *a* to the wire G I, at any place of the ſtudd I upon the index K L.

Remarks on the preceding Conſtruction.

1ſt. In this conſtruction the index K L being 12 inches long, 4 inches from the extreme end are filed ſo narrow in the direction in which it is ſeen by the eye, that any part of theſe 4 inches, lying over the diviſions of the ſcale, becomes an index thereto. The ſcale itſelf ſlides 4 inches, ſo as to be brought under any part of the 4 inches of the index, attenuated as before mentioned.

2dly. The poſition of the directing piece R R is ſo determined, as to be parallel to a right line drawn through the point o upon the ſcale, and the center K of the index; conſequently, as the attenuated part of the index forms a part of a radius, or right line from the ſame center, it follows, that whenever the index points to *o* upon the ſcale, though the ſcale is moved nearer to or further from the center of the index, yet it produces no change in the place to which the index points.

3dly. When the divided arch of the ſcale is at 10 inches from the center (that is, at its mean diſtance) then the center of the arch and the center of the index are coincident. At other diſtances, the extremes of which are 8 or 12 inches, the center of

 the

the divisions and center of the index, pointing thereto, not being coincident, the index cannot move over spaces *geometrically* proportionable to one another in all situations of the scale; yet, the whole scale not exceeding 30 degrees of a circle, it will be found on computation, that the error can never be so great as $\frac{1}{100}$th part of the scale, or 1 degree of the hygrometer; which in this instrument being considered as an indiviseable, the mechanical error will not be sensible.

Choice and Preparation of the Cord.

The cord here made use of is of flax, and betwixt $\frac{1}{20}$th and $\frac{1}{30}$th of an inch in diameter; which can readily be ascertained by measuring a number of turns made round a pencil or small stick. It is a sort of cord used in London for making nets, and is of that particular kind called by net makers *flaxen three threads laid.* I do not imagine that the fabrick of the cord is of the most material consequence; but yet I suppose, when cords can be had of similar fabrick, and nearly of the same size, that some small sources of variations will be avoided. In general I look upon it that cords, the more they are twisted, the more they vary by different degrees of moisture, and the less we are certain of their absolute length; therefore those moderately twisted, I suppose, are likely to answer best.

A competent quantity of this cord was boiled in one pound avoirdupoise of water, in which was put two pennyweights troy of common salt; the whole was reduced by boiling to 6 ℥ avoirdupoise, which

was done in about half an hour. As this aſcertains a given ſtrength of brine on taking out the cord; it may be ſuppoſed that every fibre of the cord is equally impregnated with ſalt. The cord being dried, it will be proper to ſtretch it; which may be done ſo as to prevent it from untwiſting, by tying three or four yards to two nails, againſt a wall, in an horizontal poſition, and hanging a weight of a pound or two to the middle, ſo as to make it form an obtuſe angle. This done for a week or more in a room, will lay the fibres of the cord cloſe together, and prevent its ſtretching ſo faſt after being applied to the inſtrument, as it otherwiſe would be apt to do.

I have mentioned the ſizes and principal dimenſions that I have uſed; as the inſtruments may as well be ſimilarly conſtructed as otherways; but I do not apprehend it to be very material to agree in any thing but the ſtrength of the brine on taking the cord out of it. If the cord is adapted to the inſtrument ſome days before its firſt adjuſtment, I apprehend it will be the more ſettled.

Adjuſtment of the Hygrometer.

The box cover being taken off, to prevent its being ſpoiled by fire, and chuſing a day naturally dry, ſet the inſtrument nearly upright, about a yard from a moderate fire; ſo that the cord may become dry, and the inſtrument warm, but not ſo near as would ſpoil the fineſt linen by too much heat, and yet fully evaporate the moiſture; there let the inſtrument ſtay, till the index is got as low as it will go,

now

now and then ſtroking the cord betwixt the thumb and finger downwards, in order to lay the fibres thereof cloſe together, and thereby cauſing it to lengthen as much as poſſible: when the index is thus become ſtationary, which will generally happen in about an hour (more or leſs as the air is naturally more or leſs dry), by means of the peg at top raiſe or depreſs the index, till it lays over the point *o*; this done, remove the inſtrument from the fire, and having ready ſome warm water in a teacup, take a middling camel's hair pencil; and dipping it in the water, gently anoint the cord, till it will drink up no more, and till the index becomes ſtationary, and water will no more have effect upon it; which will alſo generally happen in about an hour. If in this ſtate the index lays over the degree marked 100, all is right: if not, ſlack the ſcrew S, and ſlide the ſcale nearer to or further from the center, till the point 100 comes under the index, and then the inſtrument is adjuſted for uſe: But, if the compaſs of the ſlide is not ſufficient to effect this, as may probably happen on the firſt adjuſtment, ſlack the proper ſcrews, and move the ſliding ſtudd I nearer to or further from the center of the index, according as the angle formed by the index, between the points of dry and wet, happeneth to be too ſmall or too large for the ſcale; the quantity can eaſily be judged of, ſo as the next time to come within the compaſs of the ſlide of the ſcale; the quantity of ſlide being $\frac{1}{3}$ of the length of the index, and conſequently its compaſs of adjuſtment $\frac{1}{3}$ of the whole variable quantity. Now as ſliding the ſtudd I will vary the poſition of the index

dex reſpecting the point of *o*, this movement is only to be conſidered as a rough or preparatory adjuſtment, to bring it within the compaſs of the ſlide of the ſcale; which will not often happen to be neceſſary after the firſt time; but in this caſe, the adjuſtment muſt be repeated in the ſame manner, by drying and wetting as before deſcribed.

It is to be remarked, that, as the cord is ſuppoſed impregated in a given degree with common ſalt, and this not liable to evaporate, care muſt be taken in wetting, that no drops of wet be ſuffered to fall from the cord: for, by the obſervance hereof, the original quantity is preſerved in the cord.

Obſervations made upon two original Hygrometers.

Theſe hygrometers were firſt adjuſted, after the impregnation of the cords with common ſalt, in February 1770; they were kept together in a ſtair-caſe till the ſummer following; they were frequently obſerved, and rarely found to differ more than one degree.

In ſummer, one of them remaining in the former place, the other was removed into a paſſage through a building; which having no doors, and the inſtrument being hung ſo that neither rain nor the direct rays of the ſun could fall upon it, thereby it became expoſed to the winds, and the free paſſage of the open air. In theſe ſituations the two hygrometers not only differed very greatly in quantity, but even frequently were moving different ways. They were thus continued till January 1771, in which ſpace of time I obſerved, that the moſt ordinary place of the index

index was between 15° and 25° in the open air; that at 40° the atmosphere felt very senſibly moiſt; but yet it was frequently above 60°; and more than once at 70°, or very near. I have therefore marked the point of 0 *dry*; 20° the *mean*, 40° *moiſt*, 70° *very moiſt*, 100° *wet*. I do not, however, mean thoſe words (that of dry and wet excepted) as of any other intent, than that of general direction, in like manner as thoſe upon the barometer; leaving the relative degrees of moiſture to be judged of by the ſcale.

In the month of January laſt, I reſtored the expoſed hygrometer to its former place in the ſtaircaſe, when both inſtruments were again compared together; and they rarely differed more than 1 degree, and never ſo much as 2°. After this, they were both removed together to the out paſſage; and there they agreed nearly in the ſame manner, the utmoſt difference not exceeding 2 degrees. After ſome tryal here, one of them was readjuſted, leaving the other hanging in its place. On reſtoring the new adjuſted inſtrument to the other, they now differed about 5°, the new adjuſted one ſtanding ſo much higher. The day following the other was readjuſted alſo, and afterwards reſtored to its place with the former, which had been left in the out paſſage; and after this readjuſtment they both agreed to 1°. This being obſerved for ſome days, one of them was taken down, in order to be packed up for London; this I have now the honour of exhibiting to the Royal Society; and I beg to leave it in the Society's houſe, that in caſe any one ſhould be

deſirous

desirous of having an instrument made on the same plan, they may have recourse thereto.

It appears from the foregoing observations, that, in the compass of 11 months, the cords had stretched the value of 5°: and I also observed that they both had contracted their compass about 10°. I would, therefore recommend, that an hygrometer should from its first adjustment, be readjusted at the end of three months, and again, at the end of six months from the first; after that, at the interval of about six months, to the end of two years from the beginning; and after that, I apprehend that once a year will suffice; the best time of adjustment, being in the dry and warm weather of July or August: and by these means, I apprehend the instrument will be always kept within 2° of its proper point.

Respecting the sensibility of this instrument, it has that in a greater degree than its constancy to its scale can be depended upon, which was all that I intended; where greater degrees of sensibility are required, to make comparisons at small intervals of time, the beard of a wild oat, and other constructions may be used, with advantage; this instrument being considered as a cheque upom them as to more distant periods.

General Conclusion.

I am aware that an hygrometer actuated by any principle of the kind here made use of may not be a measurer of the quantity of moisture, actually dissolved in, and intimately mixed, with the air; but only indicates the disposition of the air to part with, or

or precipitate the water contained in its ſubſtance; or, on the contrary, to diſſolve and imbibe a greater quantity: but as it is by ſeparating the effects of natural cauſes, that we are enabled to judge of theſe cauſes, and from thence their effects when again compounded; every attempt to aſcertain the operations of a ſimple cauſe will have its value in the ſearch into nature: nor can we *a priori* determine the value of any new inſtrument; for, if it ſhould lead to a ſingle diſcovery, or even to aſcertain a ſingle fact, this may again lead to others of great importance, of which we might have, either none, or an imperfect idea of before. For my own part, I have always looked on a thick fog, and the ſweating, or condenſation of the water's vapours upon the walls in the inſide of buildings, to be the greateſt marks of a moiſt atmoſphere: whereas I have not always found the hygrometer affected at theſe times in the higheſt degree. On the contrary at the cloſe of a fine day, and the fall of the dew on the ſudden approach of a froſt, I have found the hygrometer more affected by moiſture than in ſome of the preceeding caſes; and ſtill more by a falling dew in the time of an hard froſt. I juſt mention theſe matters of hints for the enquiry of others; not having had length of time, ſince I brought the inſtrument to anſwer my intention, to make any abſolute concluſions.

I am ſorry I have been obliged to take ſo much compaſs, to deſcribe and explain a very ſimple inſtrument; but as I meant at the ſame time to give ſome idea of what is to be expected from it, I thought

it

it more excusable to be prolix than not sufficiently explicit.

London,
March 21, 1771.

J. Smeaton.

P. S. It is to be noted, that, after each readjustment, though the hygrometers would generally within a few hours come near their point, yet it was not till the next day that they could be depended on, as having come to their nearest agreement.

XXV. *Letter from Mr.* John Baptist Beccaria, *of* Turin, *F. R. S. to Mr.* John Canton, *F. R. S. on his new Phosphorus receiving several Colours, and only emitting the same.*

Clarissimo Viro

JOANNI CANTON, M. A. et Lond. Soc. Membro meritiss.

Joannes Baptista Beccaria, ex Scholiis Piis, S. P. D.

Read April 11, 1771.

THECAS plures confici curavi ex lamina ferrea cylindraceas intus nigerrimas. Operculum late pertusum crystallo occluditur, colore in theca quaque diverso. Singulis thecis offas immisi ex phosphoro calcareo-sulphureo singulas omnia pares. Hæ clausæ soli objiciuntur simul omnes; asportatas in tenebras aperio, atque offam, quæ per crystallum viridem, video virescere; rubescere, quæ per rubram; flavescere, quæ per flavam crystallum lucem imbuit: videlicet consit hoc experimento jam non quantam solum lucem ebiberit phosphorus, sed et qualem, eam ipsum unice emittere. Quod etiam experimentum Regiæ Societati obveniet fortasse non injucundum. Vale.

Summo Franklinio obsequium meo nomine, et salutem plurimam dicas rogo.

XXVI. *Some*

XXVI. *Some Remarks on the Effects of the late Cold in* February *last: in a Letter from the Rev.* R. Watſon, *Fellow of* Trinity College, *and Profeſſor of Chemiſtry at* Cambridge, *to* Mathew Maty, *M.D. Sec. R. S.*

Dear Sir,

Trin. Coll. Cam. March 21, 1771.

Read April 11, 1771.

ON the 12th of laſt February, about an hour after ſun riſing, I obſerved at Cambridge a degree of cold which is very unuſual in England, though common enough in more northern climates. Fahrenheit's thermometer, made by Dollond, as well in the open air, as when covered with ſnow, ſtood as low as 6° above 0. The Cam, by no means a rapid river, remained unfrozen; at the ſides indeed there was a little ice, and ſome ſmall flakes floating in the middle. This is no very uncommon phænomenon. The Seine was not frozen at Paris in 1709, though the cold continued for two days one degree greater than in the preſent caſe. Various reaſons have been produced, in order to account for this ſeeming deviation from the uſual courſe of nature. It hath been generally believed that

that the ſtrong current in the Seine impeded the congelation: motion will certainly hinder the parts of fluid bodies from acquiring a regular arrangement; but it may be doubted whether it will wholly prevent their coaleſcence, in any caſe where the degree of heat is leſs than what would keep them fluid if they were quieſcent. We have frequent inſtances in chemiſtry, of ſaturated ſolutions of ſalts remaining perfectly fluid whilſt at reſt, and of forming thick coagulums upon the leaſt motion. Melted metals, glaſs, reſins, &c. appear to continue fluid for a longer time, after being taken from the fire, by having their parts moved, than if they are left at reſt; becauſe the ſuperficies which is expoſed to the air is conſtantly changing, and the whole maſs becomes uniformly cold and fixed at once, as ſoon as it has parted with the heat neceſſary for its fuſion. The moſt rapid rivers would probably experience a ſimilar change, did the cold in the atmoſphere continue long enough to be communicated to the whole body of the water: for upon taking the thermometer out of the ſnow, which laid upon the bank of the river, and immerſing it into the water, it ſuddenly roſe 26°, and ſtood at 32°, or higher; ſo that the air was very conſiderably colder than the water: nor is this at all to be wondered at, when we conſider that great degrees of cold may be ſuddenly produced in the atmoſphere by cauſes which do not immediately operate upon other bodies. Thus the influx of colder air from the northern latitudes, or the deſcent of that which always remains exceedingly cold in the upper parts of the atmoſphere in the
ſame

6

ſame latitude, may in a few hours wholly change the air of a particular diſtrict: or, if from any peculiar circumſtance the air ſhould become unuſually dry, and conſequently diſpoſed to diſſolve much water, a great degree of cold might be almoſt inſtantaneouſly produced; but which could not be communicated to other bodies, in a little time, by ſo rare a fluid as the air.

During the forementioned degree of cold, a thick vapour was ſeen riſing from the ſurface, and marking as it were the courſe of the river. If we attribute the elevation of this vapour to the attraction of the air, rather than to the comparative warmth of the water (for water juſt beginning to freeze is obſerved not to loſe of its weight by evaporation *in vacuo*) the great cold may be thought perhaps to have proceeded from the ſolution of water in air which was then carrying on; for the earth was glutted with humidity, and the air was become dry, having been freed from its water by an almoſt inceſſant precipitation for three days, under the form of ſnow or ſleet. It is very remarkable, that the extreme cold of January 13, 1709, came on at Paris, with a gentle ſouth wind, and was diminiſhed when the wind changed to the north; this is accounted for by M. de la Hire, from the wind's having paſſed over the mountains of Auvergne to the ſouth of Paris, then covered with ſnow; and by Mr. Homberg, from the reflux of that air, which had been flowing for ſome time from the north. I do not ſee from what philoſophical principle it can be ſuppoſed, that the ſame air in its regreſs from a ſouthern latitude ſhould

be

be colder than in its progreſs from a northern; and as to the other opinion, the phænomenon of the cold's increaſing upon the wind's changing from north to ſouth, hath been taken notice of in other places, where there was no ſnow to refer it to. May it not deſerve to be conſidered, whether the ſudden ſolution of large quantities of aqueous vapours, brought from the ſouth into a dry northern air, be not a cauſe adequate to the effect produced? The ſolubility of water in air is diſtinctly mentioned by Dr. Halley, in the Philoſ. Tranſ. N° 192; and in the 6th Vol. of the French Encyclopedie, publiſhed in 1756; and more fully and ingeniouſly treated of by Dr. Hamilton in 1765: the cold attending the ſolution is a phænomenon ſimilar to that attending many other chemical ſolutions, and is in a leſs degree ſenſibly felt by every one who goes into a room newly waſhed, or ſtreet in the ſummer time lately watered.

Upon taking the thermometer out of the river, its bulb was quickly covered with a thin cruſt of ice, which defended it ſo much from the cold ſubſiſting in the atmoſphere, that it did not ſink two degrees in ten minutes; whereas, when it was wiped dry after immerſion in water, it ſunk above 20° in a leſs ſpace of time: this circumſtance ſhews that ice doth not tranſmit cold, and is explained by the experiments of M. Richmann, who hath eſtabliſhed it as a principle, that metallic ſubſtances are far more quickly affected in their dimenſions by the tranſitions from heat to cold, and the contrary, than any other bodies yet known.

Being defirous of obferving the effect of this extraordinary degree of cold upon various faline folutions, I haftened to my elaboratory, where I happened to have a great many folutions of falts corked up in quart bottles; the bottles were not all full, but the folutions were perfectly faturated; the ftate in which I found them is expreffed in the following table.

Frozen wholly	Frozen nearly	Wholly fluid
Alum	Green vitriol	Sea falt
Cream of Tartar	Blue vitriol	Sal gemmæ
Arfenic	Rochelle falt	Sal ammoniac
Corrof. fublimate	Glauber's falt genuine	Volatile alkaline falt
Borax	White vitriol, a few glacial fpicula	Fixt alkali per deliq.
Nitre		Epfom falts } Lymington.
		Glauber falts } Lymington.

Thefe experiments agree upon the whole very well with thofe of profeffor Braunius, related in the Peterfburgh Commentaries for 1763: for, though his faturated folutions of Epfom falts, and of fixt alkali, had begun to freeze in a lefs degree of cold, yet it is probable that his Epfom falts might have been different from thofe manufactured at Lymington, and the folution of his fixt alkali not fo well faturated as that which is made per deliquium.

During the fame froft, I endeavoured to find out the powers, by which different falts, when they are diffolved in water, refift congelation. With this view I diffolved equal weights of falts, equally dry, in equal quantities of water, and expofed the folutions

tions, when they were arrived at the ſame degree of heat, in veſſels of equal and ſimilar figures to the ſame freezing atmoſphere; and accurately marking the times in which they began to freeze, I found them obſerving the following order: firſt alum, then Rochelle ſalt, green vitriol, ſugar refined, white vitriol, vitriolated tartar, Glauber's ſalt, mineral fixt alkali, nitre, blue vitriol, volatile alkali, ſal ammoniac; laſt of all, ſea ſalt. Theſe experiments were repeated once or twice with ſome attention; yet I would not be thought to propoſe the order in which I have arranged the ſeveral ſalts, as wholly to be relied on. It were to be wiſhed, that a ſufficient number of experiments were accurately made upon this ſubject; ſome general truths relative to metallic earths, and alkaline neutral ſalts, would probably be obtained therefrom, which, however unimportant in themſelves, might ſerve, upon ſome occaſion or other, as connecting links, to extend the chain of our ideas. By this compariſon of equal quantities of different ſalts diſſolved in equal quantities of water, we might be enabled to ſpeak with as much preciſion, concerning the powers by which they reſiſt congelation, as we do concerning thoſe by which they reſiſt putrefaction. I know not whether it may not be thought too curious a remark to obſerve, that the Ocean is impregnated with that ſpecies of ſalt which reſiſts congelation with the greateſt power, and in ſuch a quantity as tends not to preſerve entire, but to accelerate the diſſolution of the numberleſs animals which are daily dying in it. Beccher, it hath been aſſerted, was acquainted with this property of common ſalt;

but

but he ſeems only to ſpeak of it as a far leſs efficacious anti-ſeptic than ſugar; at leaſt, the honour of aſcertaining the proportion in which it acts as a ſeptic undoubtedly belongs to Sir John Pringle; for Beccher, in his *Phyſica Subterranea, lib.* I. *ſect.* v. *cap.* I. where he is ſpeaking of this matter, ſays, "quod "nimius ſalis uſus corpus putreſcere faciat, ſicut "modicus a putredine præſervat."

To a table exhibiting the relative powers of neutral ſalts in reſiſting congelation, another might be uſefully added, denoting the powers of all the known acids and alkalies when diluted to a given denſity; as alſo of vinous ſpirits, from highly rectified ſpirits of wine to water impregnated with the minuteſt quantity of ſpirit. Not but that it may be conjectured *a priori*, that in this laſt caſe the reſiſtance to congelation would be directly as the quantity of ſpirit contained in given quantities of water. I made an experiment of this kind with ſea ſalt; in equal quantities of water were diſſolved quantities of ſea ſalt, increaſing in the arithmetical progreſſion, 0, 5, 10, 15, 20, &c.; the times in which the ſolutions began to freeze, reckoning from the time in which ſimple water began, increaſed accurately in the ſame progreſſion: hence it may be inferred, that, in ſalt of the ſame kind, the reſiſtance to congelation is in the direct ſimple proportion of the quantity of ſalt diſſolved; this concluſion cannot be extended to ſalts of different kinds, ſince water ſaturated with ſea ſalt is more difficultly congealed than when ſaturated with various other ſalts, which it diſſolves in greater quantities.

These observations, which are only proposed as hints to those who have more leisure for experimental enquiries, you will be so obliging as to communicate to the Royal Society, or not, as you think proper. I am,

Dear Sir,

Your most faithful

and obedient servant,

R. Watson.

XXVII. *A Letter from* Thomas Barker, *Esq*; *of* Lyndon *in* Rutlandſhire, *to* James Weſt, *Esq*; *Pref. R. S. concerning Obſervations of the Quantities of Rain fallen at that Place for ſeveral Years.*

SIR,

Lyndon, March 22, 1771.

Read April 18, 1771.

ON the other ſide is the quantity of rain, which has fallen at Lyndon in Rutland, ſince May 1736, with a table of the mean rain in the firſt four or five years, and every ten years ſince; which ſhews that there has been more rain in the latter part of this period, than in the former. But the leaſt four years were from 1740 to 43, little more than 16½ inches a year; and the greateſt four years from 1767 to 70, above 25½ inches a year. For comparing of dry ſeaſons and wet ones, I have made a table of the three drieſt months, the three drieſt two months, three, four, &c. to twelve ſucceſſive months; and a like table of wet ones: but as the years 1763, 68, 70, exceeded any others, I have made another like table of them. There are no three months come up to the laſt quarter of 1770,

7½

7½ inches of which came in three weeks, from Nov. 6 to 26; but 1763 and 68, were wetter than 70, except thoſe three months: and in this country 63 was the wetteſt; yet, by what I heard, I ſuppoſe 68 exceeded it in many places. In common ſpeaking, thoſe are called wet years, in which the ſummer, the growing ſeaſon, was wet and cold; and thoſe dry ones, wherein the ſummer was dry and burning; ſo that though 1740, 1, 2, and 3, had all but little rain, yet 42 and 43 were not properly called dry years, becauſe the ground never burned long together; and as the different degrees of heat, and frequency of rain, do not appear in this table, one cannot certainly judge, from the quantity of rain, which were the drieſt ſummers. Thoſe complained of for dry, were, 1737, 40, 41, 50, 60, 62, and 65; but the hotteſt and moſt burning were 1750, 60, and 62; and 40 and 65 were cold and dry. On the other hand, the wet years were 1738, 39, 51, 52, 56, 63, and 66 to 70; but the wetteſt 1751, 56, 63, and 68; and above all the laſt quarter of 1770.

Feb. 12 laſt, the thermometer abroad, was down at 4 of Fahrenheit's ſcale, which is lower than I have obſerved it in above 20 years paſt; the loweſt I had before obſerved, was 10½, Jan. 5, 1768. I have therefore given the riſe and fall of the thermometer for above a week in the froſt.

		Morn		Afternoon	
Feb.	8	27	N.byW.	36	E.N.E.
	9	26½	N.E.	29½	N.E.
	10	28	N.E.	33	E.by W.
	11	24½	E.S.E.	29½	S.W.
	12	4	W.by N.	31	N.W.
	13	15½	W.	30½	S.
	14	9	S.W.	25	S.S.W.
	15	12	S.W.	27½	E.
	16	31	E.by W.	35½	E.

It was remarkable, that as long as the wind continued N. E. the froſt was moderate, when it turned S. W. it became very ſevere ; and when the wind turned back into the Eaſt again, the froſt went away. This looks as if the weather was ſeverer Southward than here ; as I think was likewiſe the caſe in Feb. 1754, which was alſo a very cold ſeaſon.

I am, Sir,

Your humble ſervant;

Tho. Barker.

Lyndon, mean rain at different periods

	4 years / 5 years 36–40	10 years 40–50	10 years 50–60	10 years 60–70	34 years / 35 years 36–70	Annual quantities of rain. 1736	1737	1738	1739	1740	
Jan.	1.271	1.410	1.722	1.606	1.544		0.615	1.788	2.430	0.250	Jan.
Feb.	1.194	0.856	1.146	1.715	1.234		1.660	0.568	2.487	0.060	Feb.
Mar.	1.101	1.374	1.472	1.143	1.303		1.768	1.189	0.814	0.632	Mar.
April	1.341	1.394	1.905	1.298	1.510		0.676	1.230	2.585	0.872	April
May	1.408	1.196	1.609	1.661	1.476	0.985	1.000	2.160	1.860	1.036	May
June	1.406	2.272	2.158	2.614	2.213	0.922	0.720	2.420	1.537	1.430	June
July	2.623	2.052	2.974	2.478	2.518	6.550	0.306	0.624	1.965	3.668	July
Aug.	3.074	1.105	2.701	2.302	2.194	2.300	6.300	1.418	2.350	2.800	Aug.
Sept.	2.128	1.765	1.370	1.731	1.694	1.540	3.465	2.110	1.903	1.620	Sept.
Oct.	1.517	1.741	1.561	2.673	1.924	2.350	2.025	1.640	0.522	1.050	Oct.
Nov.	0.985	1.939	1.614	2.325	1.820	0.620	9.570	0.692	1.557	1.488	Nov.
Dec.	1.742	1.443	1.898	1.729	1.698	1.500	1.830	1.320	1.540	2.412	Dec.
	19.790	18.547	22.130	23.275	21.118	16.967	20.935	17.159	21.660	17.318	

Annual

Annual quantities of rain at Lyndon.

	1741	1742	1743	1744	1745	1746	1747	1748	1749	1750	
Jan.	1.088	1.435	0.406	1.198	0.827	1.758	2.862	0.938	2.483	1.107	Jan.
Feb.	0.618	0.863	0.365	0.941	0.572	1.706	1.211	0.369	1.017	0.894	Feb.
Mar.	0.568	0.055	1.193	1.428	2.541	1.880	1.240	1.946	1.870	1.020	Mar.
April	0.270	1.908	1.252	2.759	1.708	0.762	1.017	1.367	0.548	2.348	April
May	0.441	1.546	0.868	1.257	1.137	0.546	2.819	1.178	1.107	0.995	May
June	1.366	1.430	0.379	3.479	3.451	2.900	1.562	3.044	3.039	2.069	June
July	0.873	3.136	5.230	0.820	0.724	1.442	2.248	3.484	1.049	1.510	July
Aug.	1.633	0.160	1.124	0.957	3.934	0.456	0.071	1.305	0.767	0.640	Aug.
Sept.	4.935	1.778	0.008	3.298	0.899	1.633	1.922	0.553	0.618	1.003	Sept.
Oct.	1.460	2.386	3.088	3.142	1.460	2.274	0.582	1.060	1.086	0.875	Oct.
Nov.	1.960	2.417	0.724	2.276	2.067	1.789	4.920	0.430	0.688	2.124	Nov.
Dec.	0.490	0.163	1.427	1.168	1.233	1.279	3.624	1.549	1.674	1.827	Dec.
	15.702	17.277	16.064	22.723	20.553	18.425	24.088	17.223	16.946	16.412	

Annual quantities of rain at Lyndon.

	1751	1752	1753	1754	1755	1756	1757	1758	1759	1760	
Jan.	3.098	2.518	1.692	0.925	1.021	2.016	2.144	1.867	0.876	1.062	Jan.
Feb.	0.924	1.377	1.841	0.887	0.835	0.689	0.594	2.060	0.379	1.872	Feb.
Mar.	2.046	1.203	1.172	1.247	1.657	1.370	1.905	1.792	1.874	0.452	Mar.
April	3.086	0.827	1.395	1.455	1.965	3.899	2.090	0.917	3.026	0.389	April
May	2.656	2.134	0.980	1.400	1.393	1.258	1.371	1.269	2.739	0.890	May
June	1.847	3.084	1.007	2.883	1.811	2.973	0.375	2.160	2.970	2.470	June
July	4.989	3.678	2.595	3.849	1.585	3.197	3.002	5.023	0.927	0.895	July
Aug.	1.580	1.334	3.380	1.060	2.258	4.257	6.057	1.711	3.729	1.644	Aug.
Sept	2.614	0.480	0.706	0.107	2.546	2.080	0.518	1.465	0.854	2.333	Sept.
Oct.	1.819	0.295	1.458	1.866	1.628	1.528	1.954	1.032	1.500	2.531	Oct.
Nov.	1.338	1.090	2.112	1.960	3.138	0.975	1.498	0.912	0.980	2.134	Nov.
Dec.	1.161	3.127	3.865	2.218	1.408	0.944	2.175	1.386	1.085	1.613	Dec.
	27.158	21.147	22.203	19.857	21.245	25.186	23.683	21.594	20.939	18.285	

Annual quantities of rain at Lyndon.

	1761	1762	1763	1764	1765	1766	1767	1768	1769	1770	
Jan.	0.191	1.727	0.600	3.984	1.435	0.164	3.079	2.834	1.194	0.852	Jan.
Feb.	1.469	0.968	2.882	1.134	1.240	2.102	2.002	3.062	1.556	0.736	Feb.
Mar.	0.529	1.527	0.919	0.829	2.767	0.785	1.052	0.391	0.693	1.934	Mar.
April	0.490	0.595	0.692	1.524	2.111	1.955	0.845	2.023	0.843	1.900	April
May	2.035	0.738	2.304	1.095	0.406	3.286	2.123	1.622	1.451	1.553	May
June	3.487	0.764	2.426	2.182	0.788	2.279	2.163	4.521	4.769	2.765	June
July	0.566	1.119	5.657	4.624	0.582	2.363	3.682	2.402	1.994	1.788	July
Aug.	3.614	3.615	2.929	1.770	2.805	0.409	1.527	1.720	2.360	2.270	Aug.
Sept.	2.349	1.525	3.307	0.830	0.696	1.080	0.687	3.025	2.583	1.223	Sept.
Oct.	3.685	4.154	1.606	1.359	4.842	0.829	2.822	3.119	1.202	3.114	Oct.
Nov.	1.443	0.923	1.894	1.765	1.281	1.938	0.926	4.040	1.224	7.818	Nov.
Dec.	1.541	0.233	3.525	2.398	1.048	1.776	0.400	2.146	1.608	2.613	Dec.
	21.399	71.888	28.741	23.494	20.001	18.966	21.308	30.905	21.477	28.566	

Three drieſt ſeaſons from one month to twelve.

1 Month	Sept. 43	0.008	Mar. 42	0.055	Feb. 40	0.060
2	Jan. and Feb.	0.310	Dec. 42 Jan. 43	0.569	Feb and Mar. 40	0.692
3	Dec. 42–Feb. 43	[illegible]	Jan. — Mar. 40	0.942	Mar. — May 41	1.279
4	Jan. —April 40	1.814	Feb. — May 41	1.897	Dec. 42–Mar. 43	2.127
5	Jan. — May 40	2.850	Jan. — May 41	2.985	Dec. 42–April 43	3.379
6	Feb. — July 41	4.136	Dec. 42–May 43	4.247	Jan. to June 40	4.280
7	Dec. 42–June 43	4.626	Jan. — July 41	5.224	Dec. 39–June 40	5.930
8	Oct. 39–May 40	6.579	Jan. — Aug. 41	6.857	Nov. 42–June 43	7.043
9	Oct. 39–June 40	8.009	Nov. 36–July 37	8.865	Sept. 59–May 60	9.084
10	Sept. 39–June 40	9.912	Oct. 40–July 37	10.174	Aug. 42–May 43	10.988
11	Aug. 42–June 43	[illegible]	Sept. 40–July 41	11.794	Aug. 39–June 40	12.262
12	Aug. 40–July 41	13.427	Sept. 59–Aug. 60	14.093	July 39–June 40	14.227

Three

Three wettest seasons, from one month to twelve, except 1763, 1768, and 1770, which are below.

Month	July 36	6.550	Aug. 37	6.300	Aug. 57	6.057
	Aug. Sept. 37	9.765	July Aug. 57	9.059	July Aug. 36	9.050
3	Aug. Sept. Oct. 37	11.790	July Aug. Sept. 36	10.590	June July Aug. 56	10.427
4	July — Oct. 36	12.940	April — July 51	12.578	June — Sept. 56	12.507
5	April — Aug. 56	15.584	Mar. — July 51	14.624	Aug. — Dec. 37	14.190
6	April — Sept. 56	17.664	April — Sept. 51	16.772	Aug. 37–Jan. 38	15.978
7	April — Oct. 56	19.192	Mar. — Sept. 51	18.818	May — Nov. 61	17.179
8	Mar. — Oct. 51	20.637	Mar. — Oct. 56	20.562	July 57–Feb. 58	19.131
9	Jan. — Sept. 51	22.840	Jan. — Sept. 56	21.739	July 57–Mar. 58	20.923
10	Dec. 50–Sept. 51	24.667	Nov. 55–Aug. 56	24.205	Nov. 47–Aug. 48	22.175
11	Nov. 50–Sept. 51	26.791	Nov. 55–Sept. 56	26.285	Aug. 37–June 38	23.545
12	Nov. 50–Oct. 51	28.610	Sept. 55–Aug. 56	28.379	Aug. 57–July 58	27.290

Wetness of the Seasons in

	1763		1768		1770	
1 Month	July	5.657	June	4.521	Nov.	7.818
2	July Aug.	8.586	Oct. Nov.	7.159	Oct. Nov.	10.932
3	July — Sept.	11.893	Sept. — Nov.	10.184	Oct. — Dec.	13.545
4	June — Sept.	14.319	Sept. — Dec.	12.330	Sept. — Dec.	14.768
5	May — Sept.	16.623	June — Oct.	14.787	Aug. — Dec.	17.038
6	July — Dec.	18.918	June — Nov.	18.827	June — Nov.	18.978
7	July 63–Jan. 64	22.902	June — Dec.	20.973	June — Dec.	21.591
8	June — Jan.	25.328	May — Dec.	22.595	May — Dec.	23.144
9	May — Jan.	27.632	April — Dec.	24.618	April — Dec.	25.044
10	May — Feb.	28.766	Feb. — Nov.	25.925	Mar. — Dec.	26.978
11	May — Mar.	29.595	Jan. — Nov.	28.759	Feb. — Dec.	27.714
12	Feb. 63–Jan. 64	32.125	Jan. — Dec.	30.905	Jan. — Dec.	28.566

XXVIII. *Obser-*

XXVIII. *A second Letter from Mr.* Barker *to the President, on the same Subject; together with the Determination of the Latitude of* Stamford, *in* Lincolnshire.

SIR,

Lyndon, June 4, 1771.

Read June 13, 1771.

I AM glad the letter I sent to you for the Royal Society, was thought worth their acceptance. I have, on the other side, sent, as you desired, the height my rain measurer stands above the ground, which, if you think proper, may be added to my former letter. Mr. Edward Lawrence, who observed the rain at Stamford part of the time which I have done here, generally found more water in his measurer which stood on the ground, than I did in mine; but I cannot depend on his observations, because I have been told the servants at the house used to play him tricks, and pour into his cistern more water than fell in, to which a thing on the ground is very liable.

Mr. Lawrence also observed the latitude of Stamford with a quadrant of Mr. Sisson's making; and as it is useful to preserve such things, I have extracted the observations from his book, and shewn the latitude deduced from them.

My rain cistern has all along stood on the top of a wall, where another meets it at right angles. The top of the cistern on the North side, is 7 feet 3 inches;

 on

on the Southweſt ſide, 8 feet 6 inches; and on the Southeaſt ſide, 10 feet above the ground; it is all open Southward for 25 yards; the North ſide is an orchard, but no tree hangs over it.

The latitude of Mr. Neal's houſe, at the South end of St. Martin's, adjoining to Stamford in Lincolnſhire, as taken by Mr. Edward Lawrence, in 1736.

1ſt, By the Sun's meridian Altitude Incl. of Eclipt. 23° 28′ 20″.

	°	′	″		°	′	″		°	′	″
May 1. Alt.	55	37	0	June 18 Alt.	60	35	0	Aug. 7 Alt.	50	19	50
☉'s Decl. N.	18	16	15	Decl. N.	23	14	28	Decl. N.	12	59	16
Alt. of the Equat.	37	20	45	Equator	37	20	32	Equator	37	20	34
6	56	47	26	July 7	58	20	30	11	49	0	18
	19	27	11		20	59	16		11	39	25
	37	20	15		37	21	14		37	20	53
13	58	24	30	10	57	46	53	18	46	34	0
	21	3	10		20	25	36		9	13	7
	37	21	20		37	21	17		37	20	53
31	60	28	31	15	56	44	0	Sept. 8	38	38	30
	23	8	36		19	22	45		1	18	1
	37	19	55		37	21	15		37	20	29
June 1	60	33	32	17	56	16	26	9	38	16	0
	23	12	24		18	55	16		0	54	34
	37	21	8		37	21	10		37	21	26
2	60	37	2	20	55	33	0				
	23	15	49		18	11	50				
	37	21	13		37	21	10	greateſt	37	21	26
9	60	49	0	26	53	58	0	mean	37	20	55
	23	28	12		16	36	56	leaſt	37	19	55
	37	20	48		37	21	4				

2d, By the Meridian Altitude of the Pole ſtar.

	°	′	″		°	′	″
May 14, Alt.	50	33	0	Oct. 29, below	50	33	30
below the Pole	2	5	45	above	54	44	30
Latitude	52	38	45	Latitude	52	39	0

	°	′	″
Mean Latitude by the Sun	52	39	5
by three obſervations of the Pole ſtar	52	38	55
Mean Latitude of the S. of St. Martin's	52	39	0
St. Mary's, the middle of Stamford, is half a mile further North, therefore its Latitude is	52	39	30

I remain, Sir,

With all proper reſpect,

Your humble ſervant,

Tho. Barker.

XXIX. *Obſer-*

XXIX. *Obſervations on ſome Bivalve Inſects, found in common Water, by Mr.* Muller, *of the new Academy of Sciences in* Bavaria, *and the Oeconomical Society at* Bern; *communicated by* R. H. A. Bennet, *Eſq; F. R. S.*

Read April 18, 1771.

THE name of Bivalve is given only to thoſe ſhell-fiſh, whoſe houſes are compoſed of two parts, ſuch as muſcles and oyſters. Few of theſe are to be met with in freſh water, whereas a vaſt number are inhabitants of the ſea. I am acquainted with no more than four different ſpecies, like the ſea bivalve; they are found in the waters of Fridrickſdal, near Copenhagen, and amongſt them one has hitherto eſcaped the reſearches of conchiliogiſts.

In return, nature has liberally ſtocked the ſame waters with ſmall inſects, much more perfect than the inhabitants of the ſea-ſhells, and likewiſe provided with a double ſhell. It is ſufficiently known, that muſcles and oyſters are animals extremely ſimple; ſince they want ſeveral of the moſt perfect organs, and conſequently enjoy life in an incomplete manner. The want of eyes, arms, legs, &c. obliges them to lead an idle life, deprived of all the advantages, which

which arise from sight and motion. Nature, from which they received an habitation sufficient to protect them from external injuries, seems to have fixed for life their abode to one dark spot. Our bivalve insects, on the contrary, by opening their two folding gates, enjoy both sight and motion, alternately dipping in the mud, and darting though their element the water; whenever they meet with bad company, they hide themselves in their shells, and shut up the valves, which force and distress attempt in vain to force open.

I have discovered several different species of these animals in the waters of Friderichsdal, one only of which is known to the naturalists. Mr. Baker, of the Royal Society of London, is the first, that I know of, who mentions it; "he says*, that the "insect swims very fast; that it procures its nourish-"ment by means of a whirlpool, which it raises in "the water by means of its arms; that, upon meet-"ing with a solid body, it stops itself by means of "its feet; that upon the slightest touch it shrinks into "its shell; and lastly that it bears much resemblance "to a bivalve shell-fish." To this description he joins a figure, which, though imperfect †, represents the insect. *Linnæus* ‡, and Geoffroi || call it the *Monocle*, and without taking notice that Mr. Baker knew it already, they observe that its *antennæ* are composed of small white threads; and that the shell is oblong, smooth, and greyish, round on one side, flat on the other,

* Microscope made easy.

† Tab. XV. f. viii.

‡ *Fauna Suecica*, 1761; 2060.

|| Histoire des insectes, tom. ii, p. 657. 4°.

other, and nearly of the ſame ſize at each end. None of the above-mentioned writers have had the ſatisfaction of inſpecting the inhabitant of the ſhell, which indeed is very difficult. Now as this inſect bears a ſtrong likeneſs to the new ſpecies, which I am about to deſcribe, we ſhall take a view of both together.

As I was walking in the month of November 1767 along the ſhore, out of the Weſtern gate of Copenhagen, I ſaw in a ditch of freſh water, a *conferva* *, which I carried home with me. I immediately put a lump of it to dry upon the ſtove; after which, upon looking at it through a glaſs, I diſcovered here and there ſeveral ſmall white points, very ſmooth and ſhining. Theſe I took up upon the point of a pin, and on a cloſer view found them to be two valved ſhells hardly diſcernible. The hinge, together with the opening and figure of them, juſtified my opinion. I ſeparated the valves, and the riſing part of the hinge to the edge ſhewed them to be ſhells. I regretted that the inſect, a ſight of which was abſolutely neceſſary to rank them among the teſtaceous kind, had been deſtroyed by the heat of the ſtove. The froſt came on, and prevented my making any further enquiries. I ſhewed my ſhells to three naturaliſts of known abilities, who agreed in aſſuring me that they were of the muſcle kind. I had ſtill ſome doubt ariſing from the recollection of the inſect above-mentioned †, which I had found formerly: and I put off the deciſion, till

* Flora Fridrickſdalinſ, 1016.
† Fauna Fridrickſd. 851.

I had

I had ſeen the inhabitant alive. In the beginning of April 1768, as ſoon as the froſt broke, I got ſome more of the *confervas*, which I diſſolved in a glaſs of water without diſcovering the bivalve; nor had I any better ſucceſs upon trying the effect of the ſtove. During the ſpring, I continued my ſearch in the country, and found ſeveral ſpecies of bivalve inſects, which led me to think the inhabitant of the ſhell was like them. At laſt, in autumn, after I had given up my hopes, I found it in the Park, at the bottom of a ditch full of ſtanding waters. The tranſparency of the ſhell gave me an opportunity of examining the inhabitant; and the examination cleared up the doubt I had about its ſpecies.

The new ſhell is a bivalve; white, ſmooth, ſhining, and tranſparent, without the leaſt ſpot, hair, or down. Its figure is oblong, rounded at both ends, and the hinge ſomewhat ſinuated at the opening, and convex at the ſides, in ſuch a manner as, when ſeen out of water, it is very like the ſeeds of ſome plants; and this is common to all the ſpecies of this genus. The ſubſtance is coriacious, or like hardened glue; thin, and very brittle when dryed. When ſeen by the microſcope, ſome of them appear very like net work. The valves are equal, a little broader at one end than at the other, and ſomewhat flatted at the ſlope; they are not however more elevated at the opening than at the hinge, but rather the contrary; for on the inſide they ſhew another edge, leſs elevated than that of the outſide, and which grows leſs and leſs towards the hinge. I call by this name the place, where the valves join, though I have not been able to diſcover either the membrane or teeth, which

which ſeem to ſhut the valves in common ſhells. They are however ſtrictly joined to this place during the animal's life; which makes one think there is a ligament at the tail of the inhabitant, by which he ſhuts himſelf in. The length of the ſhell is half a line, and its greater breadth above a quarter of a line. That ſpecies mentioned by the above writers is three times longer before it comes to its full growth. It is hairy, though ſmooth to the naked eye, more indented at the ſlopes where the valves are projecting, and more depreſſed towards the hinge; it is opaque, and of a changeable colour. Some of theſe inſects are of a light and others of a dark green, marked with an oblique ſtripe of a lighter than the reſt. Some of theſe are bright, and others grey and dirty; but the down with which the ſhell is covered, and to which the dirt ſticks, is only viſible with the microſcope. I have examined ſeveral of theſe, at different ages, and at different times of the year, and have found them all rough; whereas every one of thoſe of the new ſpecies is ſmooth. I ſhall call this new ſpecies the *white ſmooth* bivalve, to diſtinguiſh it from another, the ſhell of which is white and rough; and from that of the above mentioned authors, which I call the *ſordid*, in alluſion to the dirty ſhell in which it is often found.

I have already obſerved how difficult it is to diſcover the ſhape of the inhabitants of theſe bivalves: however, the tranſparency of the *ſmooth white* one, gave me an opportunity of examining the lateral part of its inhabitant with the microſcope; and a happy accident, by which I catched the *ſordid* one at reſt upon the back of its own valves, enabled

abled me to examine its fore part through a glafs. I fufpect that it was fhedding its fkin, and for this reafon was quieter, and had its valves more open than ufually; be that as it will, I fhall now defcribe the remarkable animal I obferved.

The head is broad towards the bottom, but decreafes gradually in bulk, and terminates in a tapering point; it has on each fide a fmall long white thread, in the form of *antennæ*. The animal feems to lower and raife the point at pleafure.

The *antennæ*, are about the length of the fhell, and reft on a tranfparent cylindrical bafis, which ends in white long capillary filaments. They appear to be ftuck on at the extremity of the head, but in fact are tied to the fides, as I have often obferved the animal to lower the point of its head towards its breaft, without the *antennæ* following the motion. The *fmooth white* bivalve has five capillary threads at each *antenna*, four of which are at top, and the fifth fomewhat lower. The *fordid* appears to have ten at each *antenna*; in feveral, the *antennæ* appear yellowifh, and their bafis feems to confift of four rings.

It is by means of thefe *antennæ*, which are real fins, that the animal changes its pofition, from one place to another, being able to move them feveral ways; when it has a mind to move faft, they are firft extended ftreightways, and appear like two briftles; in an inftant the threads are unfolded, and the animal fwims with great quicknefs. As for walking, it fometimes joins the threads, fometimes unfolds only a fingle one, and fometimes fcatters them about all together; fometimes it bends them between the

 valves,

valves, which are opened towards the place of the eye; it often hides one or both of them under the breaſt between the four legs; theſe *antennæ* ſeem to afford as great an amuſement to the animal, as they do to the ſpectators.

At the place where the head joins the body, towards the border of the hinge of the ſhell, one may perceive a little black ſpot, which is the animal's eye. This extraordinary ſituation of the organ of ſight upon the neck ſeems aſtoniſhing; every thing that is new is ſo, but the ſurprize ariſes only from the narrowneſs of our ideas. Many people would give very ſpecious reaſons for this poſition; others might ſuppoſe, that if the Creator had conſulted us upon the matter, the eyes ſhould have been placed in a quite contrary poſition, towards the extremity of the head. How childiſh and weak would this be! What God does, is undoubtedly moſt perfect; and what he orders the beſt poſſible: but what we term final cauſes, are ſeldom any more than conjectures, though ſometimes they happen unexpectedly to be true. Some aquatic inſects have the eye in the forehead, others at the bottom, on the fore or back part of the head, at the ſide or under it; nay there are ſome, whoſe head conſiſts of the eye only. The plain reaſon to be given of the different poſitions of the principal organs, is at the ſame time the moſt probable, or at leaſt the moſt within our compaſs. The Governor of the world is pleaſed to give infinite variety to his works, and only obſerves the laws of uniformity in the generation of each diſtinct ſpecies.

The breaſt jets out a good deal towards the opening of the ſhell, and conſtitutes the greater part of the animal's body. The feet, mouth, and little briſtles are placed upon it.

There are four feet, whoſe poſition reſembles a good deal that of quadrupeds, only that their reciprocal bent is more marked. The two foremoſt are at the top of the breaſt, in the part where it appears moſt ſloped. I took them a great while for feelers, becauſe the animal employs them to touch things with; but another uſe it makes of them, together with the diſcovery of ſome true briſtles, makes me judge them to be legs. They are white, tranſparent, and jointed, bent towards the back legs, and terminated by two points in the ſhape of claws. The joints have very thin hair on the inferior part. The two hind legs are tied to the lower part of the breaſt. They are longer than the fore legs. Each joint has a couple of ſmall threads at the end, and each leg terminates in a claw ſomewhat lengthened; as to the reſt, they are like the fore legs, and bend towards them.

The bivalve inſect makes uſe of its claws, not only to walk upon the *conferva*, ſome parts of which are true labyrinths, and others foreſts to him; but likewiſe to remove the dirt, to ſeize its prey, and to faſten itſelf to other animals of its kind, or to neighbouring bodies.

Under the breaſt, and near the fore feet, is a black ſpot, which is the inſect's mouth; it is covered with a ſmall tranſparent ſkin, which opens in the middle, and ſhews a couple of jaws, marked with a very black ſpot at the place where they join. Between theſe jaws hang very ſmall white beards like

thoſe

thoſe of the *tipula*; and above theſe again, there appears a ſmall black tranſverſal line. About the mouth there are ſeveral other little beards, ſomewhat in the ſhape of feet, which are conſtantly in motion.

There is no doubt but that theſe ſerve to procure a free paſſage to the water, and to carry the food to the animal's mouth; which employment we can by no means aſſign to the hinder legs, as Mr. Baker, who did not ſee the parts concealed between the valves of the ſhell, has done.

The belly is almoſt as broad as the breaſt, but has ſcarce above half its length. The breadth decreaſes towards the tail. When ſeen from before, the belly appears compoſed of two conical lobes, marked in the middle with a black circle. It moves alternately to, and retires from, the breaſt.

The tail comes out between theſe two lobes; it is of the ſame length with the body, and conſiſts of two ſtreight white and tranſparent canals, which are joined together till towards the end, where they ſeparate, and each terminates in two curved points. Towards the middle of the tail, there is a little hard briſtle, upon each of the canals. The animal commonly keeps this hid under his breaſt and belly; nor have I ever ſeen it extend it, unleſs when upon the point of wanting the neceſſary water, when the animal brings it out, to put himſelf in an eaſier ſituation; after which, it is immediately drawn in back again.

Upon the back of the inſect, are likewiſe ſeen two large round bodies, which I take to be the *ovaria*.

No body, after this deſcription, will diſpute the ſuperiority which our bivalve inſect has over the bivalve

ſhell-fiſh,

ſhell-fiſh, by the wonderful conſtruction of its body, and the advantages which ariſe from it. But the difference of make is not the only one, ſince the ſhell too is formed in a quite different manner.

The ſeveral hypotheſes of naturaliſts, on the formation of ſhells, are known; ſome will have them increaſe by *intuſſuſception*, and others by *juxtapoſition*. This latter opinion, which M. de Reaumur patronized, and which nature ſeemed to juſtify, became, in conſequence, the moſt general; but if the friends of the other ſyſtem were thought to loſe their cauſe, it was only for want of obſerving with a ſufficient degree of accuracy the operations of nature, whoſe variety would have furniſhed them with inſtances in their favour. Our bivalve inſect offers one, which the deſertion of the old ſhell and the formation of a new one, in proportion as the animal grows, put beyond a doubt. The fact itſelf appears, not only from the obſervation of empty ſhells of different ſizes, which are to be met with in waters, and are nothing more than the ſpoils of our bivalve inſects; but, from the ſingular good fortune I had, in ſeeing one of the animals ſtrip itſelf, entirely, in my preſence, of the membrane of its ſhell, and of the exterior parts of its body, and ſhew itſelf at laſt before me abſolutely renewed. The *exuviæ* both of the ſhell and the animal's body were tranſparent as the brighteſt cryſtal. The joints of the *antennæ*, the briſtles, the feet, the ſmalleſt hairs, were more diſtinguiſhable than in the animal itſelf. How infinitely ſmall are the organs, which, hid as it were in ſheaths and caſes, only become viſible when they are magnified ſome thouſands of times! and how many are there which eſcape the beſt microſcope!

In

In the cleareſt water that we drink, one can often ſee with the naked eye ſpoils of this inſect, joined to thoſe of its ſhell, floating along, like fine white cotton.

This adheſion proves that the body of the animal is joined to the ſhell by ſome ligaments, which poſſibly too may keep the valves to the hinge, as I conjectured above.

I have not yet ſucceeded in diſcovering the organs of generation; nor have I ſeen the inſects in the act of copulation (which cannot be leſs extraordinary than that of the other ſpecies of the *monoculi*): ſo that I can ſay nothing of their ſex. I have obſerved that they lay eggs, but this does not prevent their being likewiſe viviparous: I have ſeen other ſpecies of *monoculi*, ſome of which had their *ovaria* full of eggs, and others of little live beaſts, which at times they hatched, and at others put down in the ſhell.

The *ſordid* ſpecies is the moſt commonly met with; one finds it all the year, even in the time of froſt, from under which I have often drawn it.

It is found in all pure waters, and even in the little ditches which are expoſed to be overflowed by the ſea. I have preſerved it from May to November, full of life and motion, in a glaſs of water, which I did not renew the whole time.

The *ſmooth white* inſect lives at the bottom of marſhes, and pools, in which the *conferva* I have mentioned grows.

As the entomologiſts have ranked the bivalve inſects under the genus of the *monoculi*, I am naturally led to ſay ſomething about this genus.

Syftematical writers have confounded aquatic infects, very different, both in fpecies and genus, under the general arbitrary name of *Monoculus*. They have not been contented with giving the fame denomination to feveral fpecies, whofe properties and attributes did not at all correfpond with the known characters of the genus, but have likewife given as fpecific marks thofe which nature tells us are generic. I fhall only mention at prefent the *fordid*, which furnifhes me with a ftriking example. M. Geoffroy, as well as Linnæus, has ranked it under the genus of the *monoculi*. According to the latter, the generic character of this, is to have two eyes and twelve feet, fix of which are fixed; whereas the former gives it only one eye and fix feet. Befides the difference as to the number of eyes, my defcription proves that the number of feet does not agree with this account. Let me add, that the particular make of the *antennæ*, the feet, the tail, and the whole body, give this infect a claim to form a genus of its own. As to the fpecific definition, *Antennis multiplicibus capillaceis, tefta bivalvi*, and whatever elfe is faid of it, if one excepts the colour only, belong equally to all my fpecies with capillary *antennæ*, and conftitute rather a definition of the whole genus, than of a particular fpecies.

The fame miftake is to be met with in feveral other fpecies brought under this genus; and the reafon of it is that the authors, not having known more than four of all the different fpecies, which I have reckoned up in the following table, have generalized the characters of thefe four, though they were not well acquainted even with thefe.

The *water parrot*, which is the beſt known, both on account of its colour, ſometimes red, which makes the vulgar believe that the water is changed into blood, and from the works of *Shæffer Baker*, *Geoffroy*, and *Swammerdam*, is repreſented by the latter as hermaphrodite, though it be different in ſex, and have the parts of generation double.

The knowledge of theſe inſects has been almoſt entirely neglected, though in reality very intereſting; not to ſpeak of their wonderful make, the difference of their motion, and their ſingular mode of copulation, are worthy of our enquiries. Let it be ſufficient to ſay, that we ſwallow them and their ſhells, either living or dead, both in our victuals and drink; ſo that I ſhould not be ſurprized, if ſome time or other they were found in our inteſtines, or in thoſe of beaſts, and ſeveral of our diſeaſes attributed to them.

I propoſe giving the deſcription and hiſtory of theſe inſects, with their figures drawn to the life, as ſeen by the microſcope: this I ſhall do in a work which I am projecting. To render it more compleat, I beg the favour of all naturaliſts to communicate their obſervations, which I ſhall not omit to give them the credit of, and at the ſame time, if they ſhould find any other ſpecies, to ſend them to me. It is very eaſy to tranſport theſe inſects, as they live very well in a ſmall quantity of water for ſeveral weeks, without a neceſſity of a change. With theſe hopes I have added a liſt of the ſeveral ſpecies, which I have met with in the waters of *Friderikſtall*. It is after having examined and compared them, at different intervals, at all ages, and in all ſeaſons of the year, that I venture to pronounce upon their ſpecific differences.

I ſhall

I ſhall take another opportunity of fixing the general ones.

Gens Monoculorum,

aquarum Friderichſdalenſium.

a Conchacei.

* Antennis capillaribus ſuperis: capite abſcondito.

1. Antennis binis: teſta ovata, tomentoſa. Fig. IV, V, VI.
2. Antennis binis: teſta ovata fuſca, ciliata.
3. Antennis binis: teſta ſubovata, candidiſſima.
4. Antennis binis: teſta reniformi, pellucida. Fig. I, II, III.
5. Antennis binis: teſta ſubreniformi, fuſca: faſciis tribus albis.
6. Antennis binis: teſta elongata; faſcia viridi.
7. Antennis binis: teſta antice truncata: ſtrigis nigris.
8. Antennis binis: teſta globoſa, glaberrima.
9. Antennis binis: teſta globoſa; faſciis tribus nigris.

** Antennis capillaribus inferis: capite exſerto.

10. Antennis binis: cauda inflexa: teſta globoſa.
11. Antennis binis: cauda inflexa: teſta oblonga.

N. B. Duas tantum antennas omni ratione proſpicere licuit, etiamſi quatuor adeſſe vix dubitem.

12. Antennis quaternis: cauda truncata: teſta globoſa.

13. Antennis quaternis: cauda inflexa lamellata: testa ventricosa.
14. Antennis quaternis: cauda erecta: testa elongata.
15. Antennis quaternis: cauda inflexa: testa antice aculeata.
16. Antennis quaternis: cauda inflexa serrulata: testa ventricosa, mutica.
17. Antennis quaternis: cauda recta: testa univalvi.
N. B. Hi potius binoculi & ultimus quidem proprii generis.

*** Antennis ramosis: capite manifesto.

18. Antennis dichotomis: cauda inflexa: testa subrhombea mutica.
Pulex non caudatus Schæff. monog. t. 1. f. 9.
19. Antennis dichotomis: cauda inflexa: testa gibba quadrangulari.
20. Antennis dichotomis: cauda inflexa verrucosa: testa postice aculeata.
Pulex caudatus Schæff. monog. t. 1. f. 1—8.
21. Antennis dichotomis: cauda inflexa: testa antice serrulata, postice aculeo longo.
22. Antennis dichotomis: cauda inflexa: testa antice ciliata: corniculis porrectis longis.
23. Antennis dichotomis: cauda inflexa: testa antice pilosa: corniculis pendulis.
24. Antennis dichotomis: cauda inflexa appendiculata: testa postice acuta.
25. Antennis dichotomis: cauda inflexa appendiculata: testa antice aculeata.
26. Antennis dichotomis: cauda deflexa: testa mutica: corniculis porrectis brevibus.

27. An-

Philos. Trans. Vol. LXI. Tab. VII. p. 245.

Fig. I.

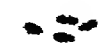


Fig. II

Fig. III.

Fig. IV.

Fig. V.

Fig. VI.

Fig. VII.

Fig. VIII.

27. Antennis dichotomis: cauda recta: testa ovata mutica.
28. Antennis trichotomis: cauda recta: testa angulis anticis setiferis.

b Cataphracti.

* Antennis binis.

29. Antennis binis simplicibus: cauda recta bifurca.
30. Antennis binis simplicibus: cauda curva bifurca, laciniis pendulis.
31. Antennis binis simplicibus: cauda biseta.
32. Antennis binis simplicibus rigidis: cauda bifida.
33. Antennis binis dichotomis: cauda inflexa.

* * Antennis quaternis.

34. Antennis quaternis simplicibus: cauda recta bifida.

Baker microscop. t. 15. f. 1—4.

Hafniæ, 24 Nov. 1768.

Otto Fridericus Müller.
Acad. Cæs. N.C. Scientiarum Boicæ, ac Societ. Oecon. Bernens.

Explanation of the Bivalve Insect, Tab. VII.

Fig. I. The smooth white insect as it is naturally.
Fig. II. The same, seen through the magnifier.
Fig. III. The same magnified by the microscope.
The transparent shell shews the inhabitant lying at its full length; with the *antennæ*, legs and tail, out of the valves.

a The edges of the two valves.
b The *antennæ*.
c The eye.

d The

d The head.
e The *ovaria*.
f The fore legs.
g The hind legs.
h The tail.
i The fore part of the breaſt, where the beards and mouth are placed.
k The belly.

Fig. IV. The *ſordid* ſhell of its natural ſize.
Fig. V. The ſame, as ſeen through the glaſs.
Fig. VI. The ſame, with the ſhell a little opened, and more magnified.
a The rough ſhell.
b The oblique ſtripe.
c The *antennæ*.
d The fore legs.
e The hind legs.
f The mouth and joints.
g The tail.
Fig. VII. The ſame, with the ſhell ſhut.

XXX. *A Letter to the Rev.* M. Lort, *B. D. F. R. S. containing an Account of a ſingular Fiſh, from the* South Seas, *by the Rev. Mr.* Michael Tyſon.

Reverend SIR,

Read May 9, 1771.

THE Rev. Mr. Farmer, Fellow of Emanuel college, Cambridge, very obligingly lent me a curious fiſh, preſerved in ſpirits, which was brought by his relation Commodore Byron, from the new-diſcovered iſlands in the South Sea. As I have the greateſt reaſon to believe that it has never been figured or deſcribed by any author, and indeed never before ſeen in Europe; I have taken the liberty to ſend you the following deſcription and drawing of it (TAB. VII. fig. VIII.). I could not count the branchioſtegous rays, without greatly injuring the ſpecimen; but there is no doubt of its being one of the *Perca* genus of Linnæus. It is called by the Commodore the *Zebra* fiſh, he not knowing its proper name. The drawing is exactly meaſured from the real fiſh, and is in every part of the ſame ſize.

Piſcis

Piſcis thoracicus.

Perca * * * * * *.

CAPUT obtuſum, anticè nudum. Os aſcendens, labiis carnoſis marginatum, mandibula inferiore longiore. Dentes in maxillâ utrâque æquales, aceroſi, approximati. Sutura maxillarum utrinque obliqua, dentata.

Opercula branchiarum ſpinis ſerrato-ciliata. Nares unicæ, rotundæ, marginatæ.

Corpus ovatum, compreſſum, ſquamoſum.

Pinnæ baſi ſquamoſæ, margine nigræ, ramentis ultra radios porrectis. Dorſales 2 ſubunitæ: prima, rotundata, radiis 10 ſpinoſis, ſecunda angulata, radiis 16 mollibus. Pectorales rotundatæ radiis 14. Ventrales radiis 6. Analis angulata radiis 14, anticis 2 ſpinoſis. Caudalis rotundata 18.

Color griſeus. Faſciæ 6 nigræ tranſverſæ totum piſcem cingunt: prima per caput ducitur, pone oculos; ſecunda per operculorum marginem; tertia angulata, obliqua, inter pinnam primam dorſi atque anum; quarta recta ab unione pinnarum dorſalium ad ſpatium pone anum; quinta arcuata inter pinnam dorſalem ſecundam et pinnam analem; ſexta rectiuſcula in baſi pinnæ caudalis.

Diagnosis.

Perca (* * * *) Pinnis dorsalibus subunitis, caudâ rotundatâ, corpore ovato: fasciis 6 transversis nigris.

I am,

REVEREND SIR,

Your most obedient

humble servant,

Bennet Coll. Camb.
March 11, 1771.

Michael Tyson.

XXXI. *An Account of* Elden Hole *in* Derbyshire; *By* J. Lloyd, *Esq*; *with some Observations upon it, by* Edward King, *Esq*; *F. R. S.*; *in a Letter to* Matthew Maty, *M. D. Sec. R. S.*

To Edward King, Esq;

Dear Sir,

Read Feb. 21, 1771.

THE inclosed is some account of Elden Hole, in Derbyshire; with the observations I made, upon being let down into it, in June last, at the time I was at Buxton-wells. If you think it any way curious, as a new account, you will be pleased to communicate it to the Royal Society.

I am, Dear Sir,

Your much obliged

humble servant,

Soughton in Flintshire,
August 4, 1770.

J. Lloyd.

A De-

A Deſcription

of ELDEN HOLE, in DERBYSHIRE.

HAVING often heard, and ſeen, ſeveral accounts of the unfathomable depth of Elden Hole, in Derbyſhire, and being in that neighbourhood, I was inclined to make what enquiries I could about that noted place, of the adjoining inhabitanrs; who informed me, that about fourteen or fifteen years ago, the owner of the paſture in which this chaſm is ſituated, having loſt ſeveral cattle, had agreed with two men for to fill it up; but they, finding no viſible effects of their labour, after having ſpent ſome days in throwing down many loads of ſtones, ventured to be let down into it, to ſee if their undertaking was practicable; when upon finding at the bottom a prodigious large cavern, they deſiſted from their work, as it would have been almoſt impoſſible to have procured a ſufficient quantity of ſtones to have filled it up.

Upon enquiry of one of theſe men whether there were any damps at the bottom; and being aſſured in the negative; I procured two ropes of forty fathom nearly in length, and eight men to let me down.

As the entrance is ſo well known, I ſhall ſay nothing further of it, than merely, that it lies near North and South in its direction lengthways; and that the opening from one of thoſe points to the other, at

the ſurface, is about thirty yards, and eight or nine yards broad.

For the firſt twenty yards I was let down (which was at the South ſide), I could aſſiſt myſelf with my hands and feet, as it was a kind of confined ſlope; but after that, the rock jetted out into large irregular pieces, on all the three ſides next me; and on that account I met with ſome difficulty in paſſing, for about the ſpace of ten yards more; at which depth the rope was moved at leaſt five or ſix yards from the perpendicular. Thence down, the breadth was about three yards, and the length at leaſt five or ſix, through craggy irregular ſlits in the rock, which was rather dirty, and covered with a kind of moſs, and pretty wet, until I came within about twelve or fourteen yards of the bottom, and then the rock opened on the Eaſt ſide, and I ſwung, till I deſcended to the floor of the cave, where I perceived there was light enough came from the mouth of the pit (though at the diſtance of forty-two perpendicular yards) to read any print. When I was at the bottom, I perceived that the cavern conſiſted of two parts; the firſt (into which I deſcended, at the place I began to ſwing) being a cave, in ſhape not much unlike to that of an oven; and the latter, a vaſt dome of the form of the inſide of a glaſs-houſe; with a ſmall arched paſſage from the one to the other, through which a ſlope of looſe ſtones (that have been thrown in from time to time) extends from the wall at the Weſt ſide of the firſt dome, to almoſt the bottom of the ſecond cave, or dome, with ſuch an angle, that the further end of the cave is lower by twenty-five yards, than the place where I firſt landed.

The

The diameter of this cavern I take to be nearly fifty yards: the top I could not trace with my eye; but had reaſon to believe it extended to a prodigious height; for, when I was nearly at the top of one of the incruſted rocks, at the height of (I dare ſay) twenty yards, I could find no cloſure of the dome, though I then ſaw much further than when I ſtood at the bottom.

As to the particular curioſities to be met with in the ſmall cavern, they are not worth mentioning; indeed I did not meet there with any ſtalactitical incruſtations whatſoever; but the wall conſiſted of rude and irregular fragments of rock.

Amongſt the ſingularities in the ſecond cavern, I particularly obſerved the following; climbing up a few looſe ſtones on the South ſide, at the place marked Q. (in the plan fig. II.), I deſcended again, through a ſmall ſlit, into a little cave, four yards long, and irregular, as to height not exceeding two yards; and the whole lined with a kind of ſparkling ſtalactites, of a fine deep yellow colour, with ſome ſmall ſtalactitical drops hanging from the roof.

Facing the firſt entrance is a moſt noble column, of the ſame kind of incruſtation (ſee D. fig. II. and IV.) which I could perceive to be above thirty yards high: and proceeding on to the North, I came to a large ſtone (marked E. fig. II. and IV.) covered with the like matter; and under it I found a hole two yards deep, lined with the ſame; from whence ſprung a rock conſiſting of vaſt ſolid round maſſes, like the former in colour, though not in figure, on which I eaſily aſcended to the height of twenty yards, and got ſome fine pieces of ſtalactites, pendent from the cragged ſides which joined this rock. At the upper part I

L perceived

perceived a small hole, or cleft; but could not, without being in danger of my life, get at it; and I found great difficulty in coming down again.

After this, proceeding forward, I came to another pile of incrustations, different from the two former, and much rougher; and which was not tinged with such a yellow, but rather with a brown colour; and at the top of this also is a small cavern, into which I went.

The last thing I took notice of was the vast drops of stalactites, hanging like icicles from every part of the vault; some of which were as large as a man's body, and at least four or five feet long.

I observed the greatest part of the walls of the large cavern was lined with incrustations, and that they were of three kinds: the first, being the deep yellow stalactites; the second, being a thin coating, like a kind of light stone-coloured varnish upon the surface of the limestone, and which glittered exceedingly by the light of the candles; and the third being a sort of rough efflorescence, every minute shoot resembling a kind of rose-flower.

Having satisfied my curiosity with a view of this astonishing vault, I began to return (observing the whole floor to be covered with vast quantities of loose stones); and reascending that heap, which I first mentioned, and so returning through the arch which separated the two vaults, I perceived, that though it is now only about three yards high, yet it must formerly (before the stones were flung in), have been a very magnificent entrance.

Once more fastening the rope to my body, I gave the signal to be drawn up, which I found to be a much more difficult and dangerous task than my descent,

deſcent, owing to my weight drawing the rope into clefts, betwixt the fragments of the rock, which made it ſtick; and to my body jarring againſt the ſides, which I could not poſſibly prevent with my hands. Another circumſtance alſo increaſed the danger, which was, the rope looſening the ſtones over my head, whoſe fall I every inſtant dreaded. As I was obliged to keep my face towards the ſide on which I was let down, I could not make any very particular obſervations on either of the rocks on each ſide of me, nor any whatſoever on the oppoſite one, except at a few reſting places, either in my deſcent or aſcent.

For the ſake of conveying a clearer idea of the deſcription, I have added two or three drawings, and a plan; which are as exact a reſemblance of the place, as my recollection will enable me to give.

And, before I conclude, I ought to mention, that under the projection of the rock at A (fig. I.) where the paſſage firſt grows narrow, and which may with difficulty be ſeen from the top, is the entrance of a cavern, that ſeems to go a great way; but I could not get into it, and therefore am not able to ſay any thing further about it.

P. S. Since writing the above, I have been informed, that a gentleman, who lives near the ſpot, affirms, there was formerly the mouth of a ſecond ſhaft in the floor of the great cavern, ſomewhere under the great heap of ſtones; and that it was covered up by the miners, at the time when ſo many loads were thrown in from the top. It is reported to have gone down a vaſt depth further, and to have had water at the

the bottom; but I did not perceive any remaining appearance of ſuch opening myſelf, nor did the miners, who went down with me, ſay any thing about it.

To Doctor Maty, Sec. R. S.

S I R,

Bedford-Row, Sept. 1, 1770.

I Have taken the liberty to ſend you, in conſequence of Mr. Lloyd's requeſt, his curious and exact account of Elden Hole in Derbyſhire: and I hope it will not be thought improper, if I venture to add a few ſhort obſervations upon it.

Mr. Lloyd, in his poſtſcript, mentions the report of there being a ſecond ſhaft, at the bottom of the great heap of ſtones: and when I was myſelf in Derbyſhire, about four years ago, and went to view the ſpot, I had an opportunity of receiving ſome information, from the wife of one of the miners, who had been down; and ſhe deſcribed the cavern in a manner agreeable to ſuch an account: for ſhe mentioned a very ſteep ſhelf, or deſcent, in the midway; at the bottom of which (ſhe ſaid) her huſband went down again a great way further, till he came to ſome water.

I do therefore conclude, that there really is ſuch a ſecond ſhaft; which having been covered up with large

large flag ſtones, or timber (probably by the miners) to facilitate, if poſſible, the filling up of Elden Hole, ſtill remains buried under the heap of ſtones. And I do alſo ſuppoſe, that the great ſlope of ſtones, which Mr. Lloyd deſcribes, is not entirely compoſed of looſe ſtones from time to time flung in; but that under them is the original ſhelf of ſolid rock, much ſteeper than the preſent ſlope, and ſomething in the direction S D fig. V. with the mouth of the ſecond ſhaft near the end of it. And this ſuppoſition, together with Mr. Lloyd's exact deſcription of the parts of the cavern which he ſaw, will perhaps reconcile all the accounts that have been given of this moſt aſtoniſhing chaſm.

For, ſtones flung down, or let down by ropes, in a proper direction, would certainly ſlide along the ſhelf of rock, and deſcend into the ſecond ſhaft, before it was covered up; whereas others would reſt at the bottom of the firſt ſhaft, or in the great cave: and hence the depths obſerved by different perſons, at different times, muſt have varied greatly from one another.

And if it be further conſidered, that, in ſounding ſuch great depths, the weight of the rope may often be miſtaken for the weight of the plummet; and that hence the rope may continue deſcending, and coiling up, firſt at the bottom, and afterwards at other places where it is accidentally ſtopped, till it be at length hindered in its deſcent by ſome projections of the rock nearer the mouth of the ſhaft; this will account for Mr. Cotton's letting down 884 yards; whilſt the water at the bottom of the ſecond ſhaft will account for 80 yards being wet; as ſo many

 might

might coil up in the water (let it have been ever ſo ſhallow), and as the reſt, beyond the real depth of the chaſm, might coil up either in the great or little cave.

Again, the many craggs on each ſide the firſt ſhaft, (and probably alſo on each ſide the ſecond) muſt retard any ſtone in its fall; and by that means will account for the length of time a body takes in deſcending; which muſt be a great deal longer than if it fell in open ſpace: and hence Dr. Short (who has given us a calculation, formed from the time of the deſcent of heavy bodies, according to the Newtonian principles of gravitation) was miſled to conclude, though very ingeniouſly, that this chaſm was 422 yards deep.

And laſtly; the falling of ſtones into the water, at the bottom of the ſecond ſhaft, and the increaſe of the ſound made thereby, partly from the reverberation at the ſides of the great cavern, and partly from the form of the upper ſhaft (which is not very unlike that of a ſpeaking trumpet, ſee fig. I.) might occaſion that aſtoniſhing noiſe, which is ſaid to have been heard at various times formerly, on throwing ſtones into this gulph; but which has not been heard of late years, in a manner at all agreeable to old reports.

And now, Sir, I cannot forbear to take notice, that as both Mr. Lloyd, and alſo the miner's wife, from whom I had my information, mentioned there being water at the bottom of the ſecond ſhaft, it appears highly probable, that this water is the continuation of a ſubterraneous river; and indeed of that very river which runs out of the mouth of the great

cavern

cavern at Caſtleton: for it is obſerved by the country-people in the neighbourhood, that there is a large quantity of grit ſtone grows in the earth near Elden Hole, but none near Caſtleton; and yet, on high floods, the river at Caſtleton waſhes great quantities of fragments of that very grit-ſtone, out of the mouth of Caſtleton cavern.

There is alſo a tradition, which, however ridiculous it appears at firſt ſight, ought to have ſome little weight; eſpecially if compared with what Keyſler and Dr. Brown * relate of the Zirchnitzer ſea in Carniola. The tradition is this, that many years ago, a poor old woman, hunting her gooſe, it fled from her, and at laſt fell down into Elden Hole, to her great ſorrow; but ſome days after, ſhe heard it was ſeen at the mouth of Caſtleton cavern, and actually received it ſafe again from thence: the gooſe having, by the fluttering of its wings, preſerved itſelf from being daſhed to pieces in its fall; and having found its paſſage ſafely through the ſubterraneous river.

I have added theſe few obſervations, for the ſake of preſerving the tradition cocerning the ſecond ſhaft, which otherwiſe perhaps would very ſoon be loſt; and alſo for the ſake of ſhewing how great a probability there is of its being true: and to explain the matter more fully, I have ventured to add a fifth drawing, though merely from conjecture.

But before I conclude, I muſt beg leave to obſerve, that the diſpoſition of the maſſes of ſtalactites in this cavern, ſeems to me to deſerve ſome attention. Of the three great piles of incruſtations, two manifeſtly

* See Keyſler's Travels 8vo. Vol. IV. p. 140, and Lowthorp's Abridgement of the Philoſophical Tranſactions, Vol. II. p. 306.

 deſcend

deſcend from two chaſms (H and G fig. IV.) in the ſides of the cavern; and therefore ſeem to have been formed by the water draining, and dripping at times, through thoſe chaſms, and carrying with it the ſtalactitical matter: and it is remarkable that the pile (I, Fig. IV.) from the larger chaſm, is coarſer, and rougher, and of a more earthy colour, than that from the ſmaller chaſm. But the third and largeſt column of ſtalactites, (D, Fig. IV.) has no chaſm in the rock at its top; and is of a finer kind than the two others; and conſiſts of perpendicular ſpires; whereas the others conſiſt of large miſ-ſhapen lumps. And it is moſt remarkable, that this ſtands very near the end of the ſlope of ſtones; and conſequently, that ſomewhere near it muſt be the mouth of the ſecond ſhaft, if ſuch really exiſts.

As therefore Dr. Browne, in his travels (p. 96, 4to.) mentions ſtalactites formed on the irons in the cupola of the baths at Buda, by the *exhalations* from the baths; and as ſo many of the waters in Derbyſhire are warm, and mineral; I would beg leave to ſubmit it to the conſideration of the curious, whether this column, in particular, and the thin coating of ſtalactites, on all the walls of the great cavern, mentioned by Mr. Lloyd, were not moſt probably formed by *exhalations* from the ſecond ſhaft; whilſt the other two columns, and the ſtalactites pendent from the roof, were formed by water and ſtalactitical matter tranſuding through the chaſms above-mentioned, and through the pores of the ſtone? I am, Sir,

With great reſpect, your much obliged,

and moſt obedient humble ſervant,

Edward King.

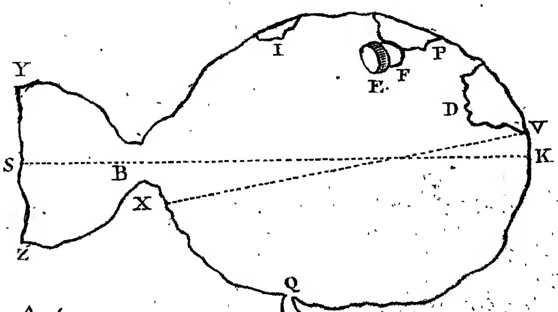


Fig. II.

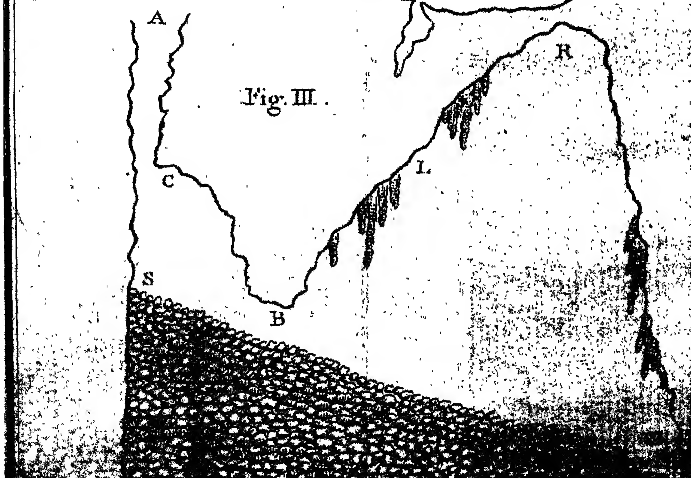


Fig. III.

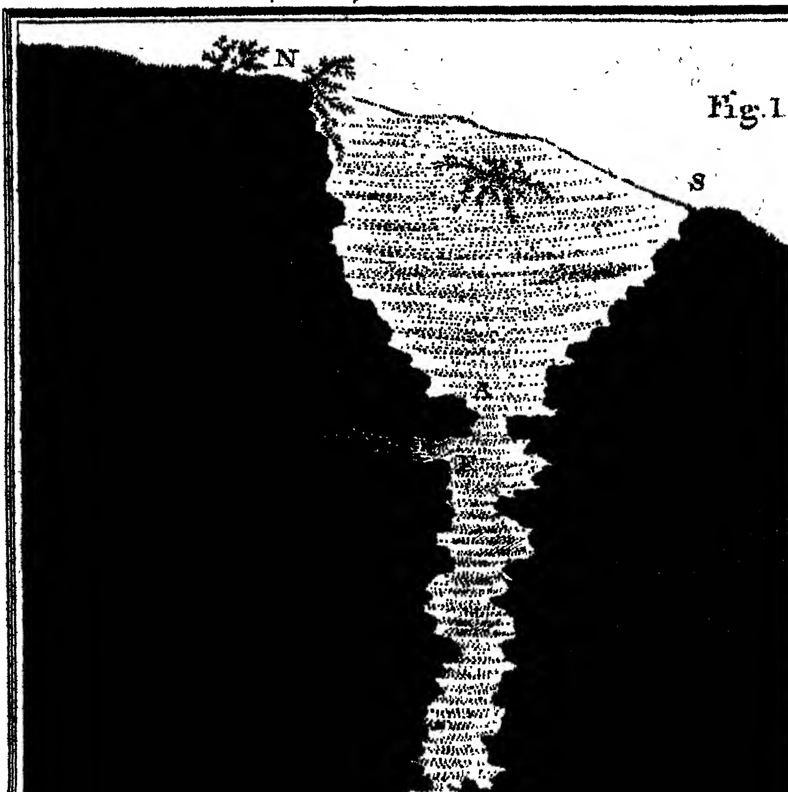


Fig. 1.

Explanation of PLATE VIII.

Fig. I.

A Section of the Great Shaft, and First Cave.

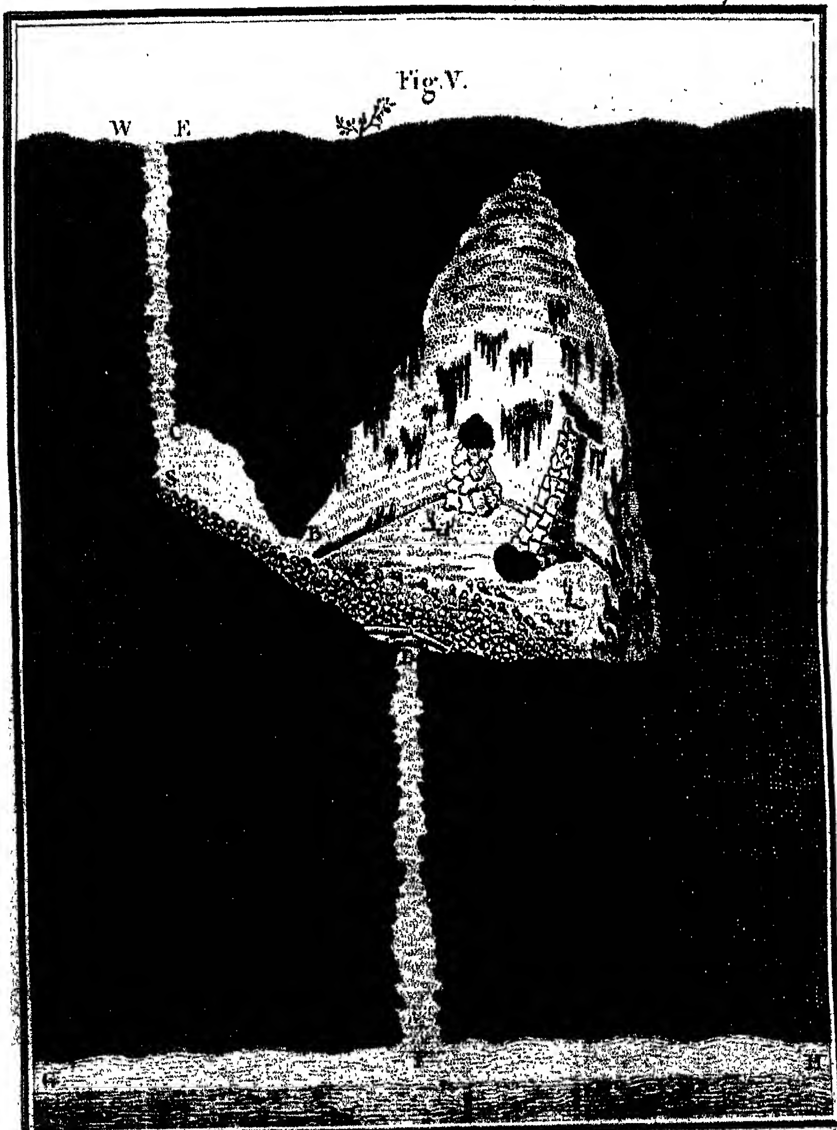
N S	The mouth of the Chasm lengthways from North to South.
S	The South end, at which I was let down.
A	The first great cragg, where the passage grows narrow. Opposite to it is a large projection of the rock, which may be just seen from the top: and under that is,
F	The entrance of a cavern, which seemed to go a great way; but I could not get into it.
C	A large projection of the rock, at the bottom of the shaft. As soon as I had passed this, I swung; being come into the first Cave.
D E	The heap of stones, with which the whole bottom of the first cave is filled.
B	The arched passage into the great vault, being about three yards high.

Fig.

Fig. II.

The Plan of the Caves.

YZB	The floor of the firft cave. Y The North end. Z The South end.
YZ	The flat wall of rock, on the Weft fide.
B	The entrance into the great cavern, on the Eaft fide.
BXQKVPI	The floor of the great cavern.
Q	A little, narrow, irregular cave.
D	The bafe of a column of ftalactites, above 30 yards high.
P	The bafe of the rock of more folid and round maffes of ftalactites.
E	The great ftone, which covers part of the mouth of
F	A pit, or hole, two yards deep, lined with yellow ftalactites like ftucco.
I	The bafe of a pile of encrufted ftones, which lead up to a fmall cave.
SK	The direction of the fection fig. III.
XV	The direction of the fection of the great cavern, fig. IV.



Basire sculp.

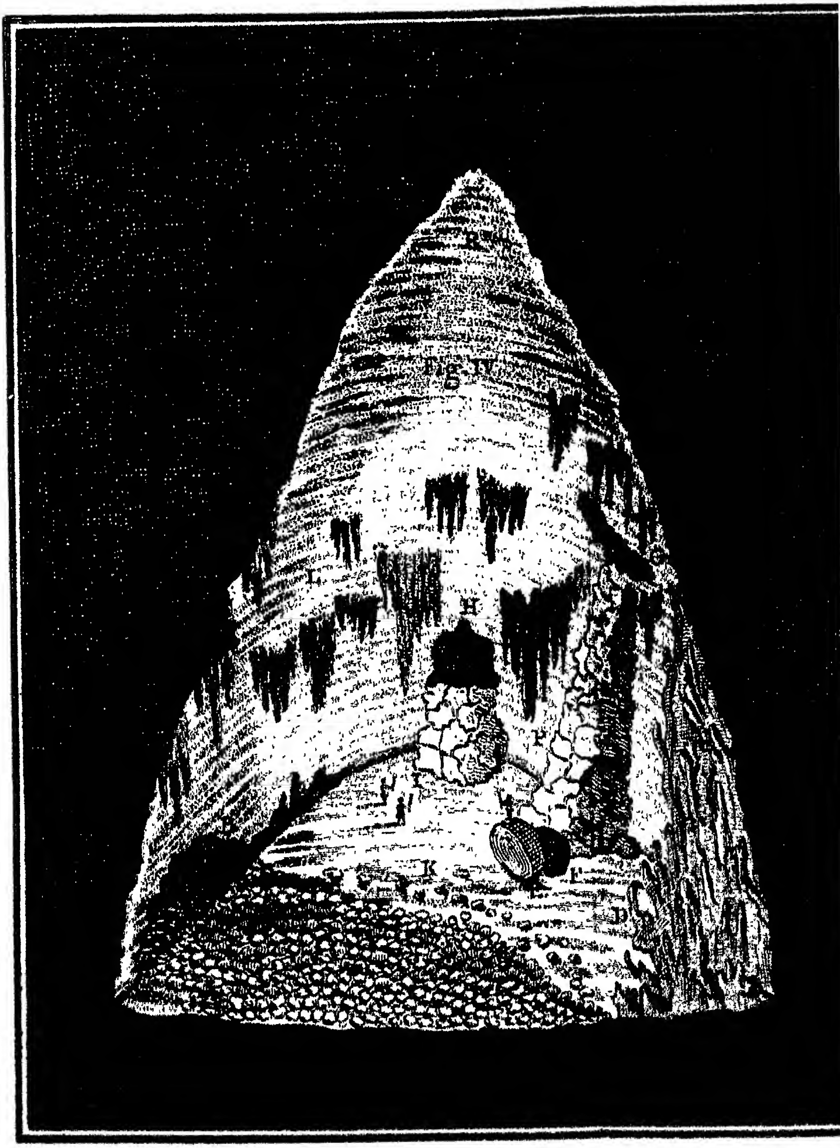


Fig. III.

AC The ſhaft where I was let down.

C The place where I began to ſwing, in the ſmall cave.

AS The perpendicular wall of rock on the Weſt ſide.

B The entrance into the great cavern on the Eaſt ſide.

RT The great Vault or Dome.

ST The heap of ſtones, which have been flung in from time to time.

I Large drops of ſtalactites, in cluſters.

Explanation of Plate IX.

Fig. IV.

The inſide of the great Cavern.

B The entrance on the Weſt ſide.

K The continuation of the vaſt heap of ſtones.

D The column of ſtalactites, above 30 yards high.

E The great ſtone which covers part of the mouth of

F A pit or hole, two yards deep, lined with ſtalactites like ſtucco.

P The rock of more ſolid and round maſſes of ſtalactites, on which I aſcended about 20 yards.

G A cleft in the rock at the top of the pile.

I A pile of incruſted ſtones, which leads up to a ſmall cave H.

L Large drops of ſtalactites, hanging in large cluſters.

R The roof (probably ſomewhat of this form) but too high to be ſeen.

Fig. V.

A View of all the Caverns, with the ſecond Shaft.

WE The mouth of Elden Hole. W The Weſt ſide. E The Eaſt.

C The entrance into the leſſer cave.

B The paſſage into the great cavern.

R The roof of the great cavern, reaching nearly to the ſurface of the ground.

ST The ſlope formed by the heap of ſtones.

SD The ſteep ſhelf of rock, probably, under it.

D The mouth of the ſecond ſhaft, which very probably ſtill exiſts; but is covered up, ſomewhat in the manner here repreſented.

F The bottom of the ſecond ſhaft.

G H A ſubterraneous river, at the bottom of the ſecond ſhaft; which probably communicates with ſome of the rivers in that great cavern at Caſtleton: a circumſtance there is reaſon to ſuſpect, from hence, that thoſe rivers, on great floods, are obſerved to caſt up ſmall fragments of a kind of grit ſtone, which grows plentifully in the parts of the country near Elden Hole; but is not to be found in the parts near the cavern at Caſtleton.

XXXII. *An Account of two new Tortoiſes; in a Letter to* Matthew Maty, *M. D. Sec. R. S.: By* Thomas Pennant, *Eſq; F. R. S.*

SIR,

Read May 2, 1771.

I BEG the favour of you to lay before the Royal Society, an account of two tortoiſes that have juſt fallen into my hands.

The firſt was communicated to me * by my worthy and learned correſpondent Doctor Garden, of Charles Town, in South Carolina; a gentleman to whom the world is indebted for various information relating to the natural hiſtory of that province; and whoſe aſſiduity promiſes fair to enable me to make conſiderable additions to the accounts already given of the new world. He has favoured me with an ample deſcription of this new animal; together with ſome relation of its manners; both of which are now delivered to the Society in the words of the ingenious writer.

* The ſpecimen now under the inſpection of the Society, was lent me, by my good friend Mr. Ellis; my own ſpecimen being in the country: to Mr. Ellis I was alſo indebted for the elegant drawing of the animal, done from the life, in South Carolina.

" I

" I now come to ſpeak of a ſpecies of Turtle or
" Tortoiſe, peculiar to our ſouthern rivers. We call
" it the *ſoft ſhelled* Turtle; becauſe, when alive, the
" covering looks like leather, very ſmooth and pli-
" able, without any appearance of bone in it. It is
" very ſwift and fierce. They are not commonly
" got here in Charles-town, though by chance
" this laſt ſummer, I had two ſent me. One of
" them I had preſerved entire and ſent to our friend
" Mr. Ellis; the other, leſs perfect, I have ſent you.
" This is a very curious animal, and I think, a non-
" deſcript, for there is none of Linnæus's fifteen
" ſpecies, that reſemble it, except the firſt; and
" that, he particularly mentions, is found in the
" * Mediterranean; but this always inhabits freſh
" waters, remote from the ſea. The head and ſnout
" are particularly diſtinguiſhed from every other
" Turtle; and what is more, I am told they ex-
" ceed any turtle in the delicacy of their taſte and
" flavour. I never eat any of them; but have heard
" many ſpeak of them who were great epicures, and
" they have aſſured me, that they were far preferable
" to the green kind."

* There are two ſpecies of Tortoiſes in that ſea, a coriaceous one, and another reſembling that of the Weſt Indies, which is ſcarce eatable. The laſt I procured from Leghorn, and at this time am doubtful whether it differs ſpecifically from the Weſt Indian Turtle.

Fresh Water Turtle, commonly called Soft Shelled Turtle. TAB. X.

" THEY are found in large quantities in Savannah and Alatamaha rivers; and I have been told that they are very common in the rivers in East Florida.

" They grow to very large sizes, though the largest that ever I heard of was seventy pounds.

" The Turtle, which I now have by me, weighs twenty pounds; and probably, when I first got it, it might have weighed from twenty-five to thirty pounds, as I have observed that it has grown poorer every day. I have had it now near three months, and I never could observe that it has eaten any thing that has been given it, though a variety of things have been tried.

" It is twenty inches long from one end of the shell or covering to the other, and fourteen inches and a half broad. The colour of this shell or covering, in general, is dark brown, with a greenish cast.

" The middle part is hard, strong, and bony; but all round the sides, especially towards the tail and hindermost part, it is cartilaginous, soft and pliable, resembling thick tanned sole-leather, yielding very easily to any force in any direction whatever, but thick enough and strong enough to defend the animal from any injury. All the hind part of the back is full of oblong smooth knobs; and the fore part, just where it covers the head and neck, is studded full of large knobs. The under side of this plate is very beautiful,

Fig. 1.

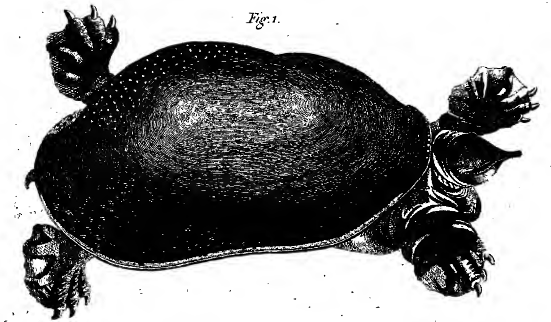


Fig. 4.

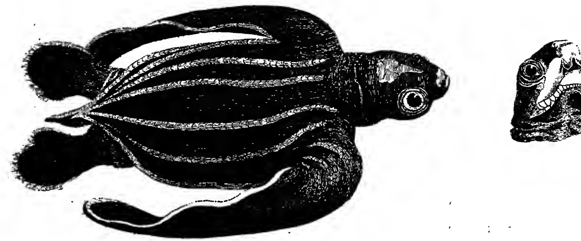


Fig. 2.

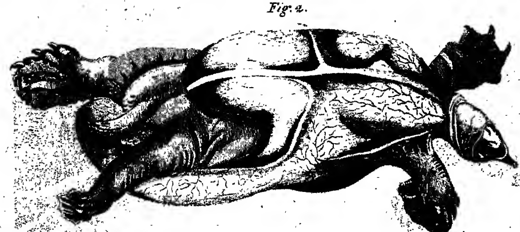
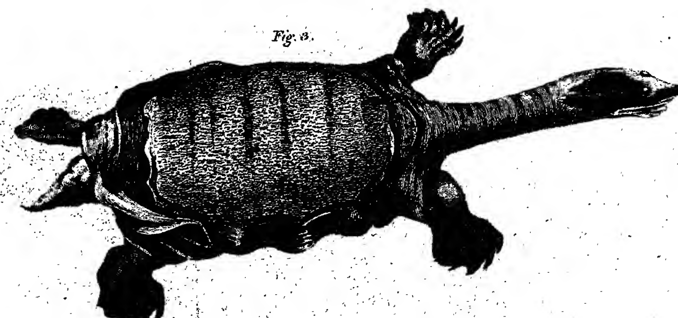


Fig. 3.



beautiful, of a lively whitiſh colour, interſperſed with innumerable very fine ramifications of blood veſſels, running from the margin of the plate into larger and larger branches, until the ſight of them is at once loſt by their entering the body of the animal.

" The under, or belly plate, or rather *ſternum*, is of a fair whitiſh colour, and extended forward two or three inches more than the back plate, ſo that the head reſts on it very conveniently. The hind part of this plate is hard and bony, ſhaped very much like a man's riding ſaddle, with two pieces for the thighs to reſt on. The fore part of the plate is pliable and cartilaginous.

" The head is ſomewhat triangular and attenuated, rather apparently ſmall for the animal, but growing gradually larger towards the neck, which is thick and long, and eaſily extended out (the neck of the preſent ſubject was thirteen inches and a half long) to a great length, or drawn back again under the ſhell or plate.

" The eyes are placed in the fore and upper part of the head, near to one another, having pretty large looſe palpebræ. The pupil is ſmall and lively, ſurrounded by a lemon-coloured *iris*, perfectly round, and giving much life and fire to the eyes. When danger approaches, or when it goes to ſleep, it covers its eyes, by bringing the inner and looſe part of the lower *palpebræ* over its eye, like a *membrana nictitans*.

" The upper lip and under lip are both large, but eſpecially the upper. The *mandibula* are both entire, each being one entire bone all round, of the ſame ſhape as the mouth.

" The

" The noftrils are the moft fingular part, being a cartilaginous production of at leaft three quarters of an inch, beyond the upper and fore angle or point of the upper lip, perforated with two apertures reaching back and opening into the roof of its mouth, having a fmooth *feptum* but fimbriated upon each fide. This, at firft fight, in fome manner refembles the fnout of the mole; but it is tender, thin and tranfparent, and cannot be intended for digging in the earth or land.

" The arms are thick and ftrong, confifting of three diftinct joints, *viz.* the upper, the fore arm, and hand. The hands have each five fingers, of which the three firft are fhorter and ftronger, and furnifhed with ftrong nails, or rather claws. The two laft fingers have more joints, but are fmaller, and, inftead of being furnifhed with claws, are covered with the membrane, which is extended even beyond their extremities. Towards the back or hind part, there are two fpurious fingers, which juft ferve to fupport the membrane when extended. The upper fide of thefe arms and hands are covered with a wrinkled loofe fkin, of a dufky greenifh colour. The legs confift of the fame number of joints, and have the fame number of toes as there are fingers on the fore-feet, and thefe are furnifhed with nails in the fame manner, only there is but one fpurious toe. Both the fore and hind legs are thick, ftrong, and mufcular; and as the animal is very fierce, when it is attacked or difturbed, it often raifes itfelf on its legs, and will leap forward to bite its difturber or enemy, which it does with great fury and violence.

" They

" They are likewiſe very ſtrong, and of a lively whitiſh colour, becauſe they are generally, if not always, covered with the upper plate, which, as I ſaid before, is extended a great way behind.

" The tail is large and thick, and generally as long as the hind part of the upper plate. The anus is placed about an inch from the extremity of the tail on the inſide.

" The Turtle, from which theſe characters were taken, was a female; after ſhe came into my poſſeſſion ſhe laid fifteen eggs, and about the ſame number were taken out of the belly when ſhe died. The eggs were nearly an inch diameter, and perfectly ſpherical.

" It is eſteemed very good eating, and ſaid by many to be more delicate than the green turtle."

The other Species of Tortoiſe, which I name

the Tuberculated,

was communicated to me by Mr. Humphries, of St. Martin's-Lane, merchant of minerals, ſhells, and inſects. He was unacquainted with its place and hiſtory; therefore I muſt content myſelf with giving a meer deſcription of it, deprived as I am of the knowlege of its manners and uſes, without which even natural hiſtory is as replete with dulneſs as with inutility.

Its length, from nofe to the extremity of the back, is three inches three lines; its greateft breadth, one inch and a half.

The head is large and fcaly. The neck thick and wrinkled. Eyes full; noftrils fmall and oval; the end of the upper mandible long and bifurcated, lapping very far over the lower.

The back is divided length-ways, with five prominent ribs covered with large yellow tubercles, the intervening part is dufky and divided by multitudes of leffer and more depreffed tubercules. The whole circumference of the back bounded by a tuberculated rib, like thofe on the upper part. The extremity furcated. The whole is coriaceous and pliant.

The tail is depreffed fideways, tapers to a point, and reaches beyond the end of the back.

The belly is yellow, tuberculated like the back, but marked with fix rows greatly prominent.

The prior fins are longer than the whole body, very thin, dufky, and edged on their interior fides with white, and both the furfaces are covered with depreffed tubercles. The hind fins are broad, much dilated near their end, and flightly bilobated: none of thefe fins had the left marks of toes or nails.

This may probably be the fame with the *Teftudo coriacea* of *Linnæus*, p. 350, or the coriaceous one above mentioned: but, as I have not at prefent before me the authors cited by that able naturalift, I will not pretend to pronounce with certainty whether it is the fame.

Explanation of the Figures.

TAB. X.

Fig. 1. The ſoft-ſhelled Tortoiſe.
2. The ſame on its back.
3. The ſame with its neck exerted; drawn from the dried animal.
4. The tuberculated Tortoiſe.
5. Exhibits the form of the mouth.

XXXIII. *Meteorological Observations at* Caën *in* Normandy; *for* 1765, 1766, 1767, 1768, 1769. *By* Nathanael Pigott, *Esq; communicated by the late Dr.* Bevis, *F.R.S.*

Read May 9, 1771.

1765.

Months	Days	Barometer.	Inches	Mean	Ther.	Mean	Remarks
January	31 9	Greateſt height Leaſt ditto	30,20 29,10	29,65			Wind chiefly S.S.W. 15th froſt in the morning; the reſt of the month was cloudy.
	8 31	Greateſt ditto Leaſt ditto			46.5 37,5	42	
February	24 28	Greateſt ditto Leaſt ditto	30,14 28,87	29,505			Wind chiefly N. and E. N. E. 4th froſt and cloudy; 18th, 19th, 20th, 21ſt, 24th, 26th, ſmall froſt; 27th thaw; 28th rainy.
	27 19	Greateſt ditto Leaſt ditto			44,5 33 5	39	
March	8 23 1	Greateſt ditto Leaſt ditto	30 02 28,97	29,495			Wind chiefly S. S. W. 11th, 12th, 14th, 19th, 20th, 27th, 28th, high wind; 13th, 18th, 30th, 31ſt, ſtormy.
	24 1	Greateſt ditto Leaſt ditto			51,0 40,0	45,5	
April	12 20	Greateſt ditto Leaſt ditto	30,38 29,57	29,975			Wind variable; 1ſt ſtormy; 4th, 6th, 7th, 8th, 9th, 10th, 13th, 14th, 15th, 22d, high wind; ſky almoſt always cloudy: 2d ſome ſwallows: 26th ſome thunder: fruit trees begin to bloom.
	27 28 13	Greateſt ditto Leaſt ditto			67,5 47,5	57,5	
May	12 15 24	Greateſt ditto Leaſt ditto	30,24 29,56	29,90			Wind moſtly in the N. points: this month remarkable for fine ſun, and clear ſky.
	22 23 5	Greateſt ditto Leaſt ditto			67,0 53,0	60,0	
June	9 16 17	Greateſt ditto Leaſt ditto	30,22 29,78	30,00			Wind moſtly in the North points: weather changeable the whole month: 3d ſome thunder and lightening with heavy rain at 4h P. M.
	4 5 29 30	Greateſt ditto Leaſt ditto			70,0 61,0	65,5	

Month

Meteorological Obfervations, at Caën in Normandy.

1765.

Months	Days	Barometer	Inches	Mean	Ther.	Mean	Remarks
July	4 7	Greateft height Leaft ditto	30,28 29,70	29 99			Wind moft in the northern points; beginning, cloudy fky; middle, fun with clouds; end, windy and fun with flying clouds; 25th at 7h. P.M. therm. 77°.
	19 25 1	Greateft ditto Leaft ditto			72,0 52,0	67,0	
Auguft	18 22	Greateft ditto Leaft ditto	30,30 29,03	29,66 +			Thefe obfervations are from the 10th to the 24th only. Wind variable; the beginning fhowery; 12th ftormy; end, funfhine and clouds.
	23 12	Greateft ditto Leaft ditto			76,0 59,0	67,5	
November	21 25	Greateft ditto Leaft ditto	30,27 29,02	29,645			Wind variable: beginning rainy; middle foggy; end, white froft in the mornings.
	1 23 24	Greateft ditto Leaft ditto			56,0 42,0	49,0	
December	16 11	Greateft ditto Leaft ditto	30,34 29,12	29,73			Wind chiefly in the Eaft points: beginning frofty: 5th hard froft; 8th, 9th, 10th, 11th, rain; remainder, almoft conftant froft.
	8 25	Greateft ditto Leaft ditto			51,0 37,0	44,0	

1766.

Months	Days	Barometer	Inches	Mean	Ther.	Mean	Remarks
January	29 2 3	Greateft ditto Leaft ditto	30,72 30,03	30,375			Wind chiefly E. S, E. from the beginning till the 20th, foggy and cloudy till the 30th; 31ft, froft, 29th, 30th, 72 inches: height of barometer carefully fet down.
	31 11	Greateft ditto Leaft ditto			40,0 27,0	33,5	
February	19 17	Greateft ditto Leaft ditto	30,61 29,52	30,065			In the beginning wind in the North points; in the middle in the South; at the end to the Northern points; froft till 11th; wind and rainy till the end.
	15 8	Greateft ditto Leaft ditto			45,0 30,0	37,5	

Meteorological Obſervations at Caën in Normandy.

1766.

Month	Days	Barometer	Inches	Mean	Ther.	Mean	Remarks
March	7	Greateſt height	30,29	29,565			Wind variable; 1ſt, 22d, ſtormy; 26th hurricane; 23d, 24th, 25th, wind and ſnow in the nights. The whole month moſtly cloudy: from 25th to 26th, quickſilver fell in barometer 0,67 inches.
	26	Leaſt ditto	28,84				
	13	Greateſt ditto			53,0	46,5	
	1 3	Leaſt ditto			40,0		
April	7	Greateſt ditto	30,40	29,875			Wind variable; moſt part of the month rain and wind.
	24	Leaſt ditto	29,35				
	27	Greateſt ditto			57,0	52,5	
	1	Leaſt ditto			48,0		
July	4	Greateſt ditto	30,08	29,885			Theſe obſervations from the 2d to the 16th only. Wind variable; cloudy and rainy.
	9	Leaſt ditto	29,69				
	10	Greateſt ditto			70,5	66,75	
	3	Leaſt ditto			63,0		
Auguſt	26	Greateſt ditto	30,27	30,065			Wind at beginning in the North points; middle variable; end in the South points. Clouds and wind almoſt the whole month.
	22	Leaſt ditto	29,86				
	9	Greateſt ditto			76,0	70,0	
	17	Leaſt ditto			64,0		
September	17	Greateſt ditto	30,38	29,99			Wind till towards the end varying; from the 25th S. S. E. Clouds and wind the whole month.
	7	Leaſt ditto	29,60				
	27	Greateſt ditto			72,0	66,0	
	16	Leaſt ditto			60,0		
October	2	Greateſt ditto	29,84	29,555			Wind moſtly E. S. E. the end of the month variable; clouds and wind; 6th ſtormy: theſe obſervations from the 1ſt to the 10th only.
	8	Leaſt ditto	29,27				
	5	Greateſt ditto			70,0	66	
	9	Leaſt ditto			62,0		

Mete-

Meteorological Obſervations, at Caën in Normandy.

1767.

Months	Days	Barometer	Inches	Mean	The.	Mean	Remarks
January	21	Greateſt height	30,10	29,575			Wind moſtly S. S. E. this month froſty; ſometimes ſharp and high winds.
	13	Leaſt ditto	29,05				
	30	Greateſt ditto			52,0	41,25	
	3	Leaſt ditto			30,5		
February	12	Greateſt ditto	30,03	29,665			Wind moſt in the South points. Rainy and windy from the 9th to the 15th. Theſe obſervations only down to the 15th.
	8	Leaſt ditto	29,30				
	15	Greateſt ditto			54,0	52,0	
	10	Leaſt ditto			50,0		
May	24	Greateſt ditto	33,30	29,86			Wind varying the whole month. moſtly rainy and windy.
	30	Leaſt ditto	29,42				
	16	Greateſt ditto			62,0	58,5	
	4	Leaſt ditto			55,0		
June	10	Greateſt ditto	30,15	29,77			Wind varying. 3d ſtormy; the whole month windy and rainy.
	3	Leaſt ditto	29,39				
	29	Greateſt ditto			65,5	60,25	
	3	Leaſt ditto			55,0		
July	18	Greateſt ditto	30,02	29,825			Wind varying. 21ſt ſtormy; from the 11th to the 30th cloudy and rainy. Few flies yet in the appartments, and thoſe cannot fly.
	21	Leaſt ditto	29,63				
	16	Greateſt ditto			67,0	65,0	
	12	Leaſt ditto			63,0		
September	13	Greateſt ditto	30,16	29,89			Theſe obſervations only from the 1ſt to the 15th; wind varying; weather changeable.
	4	Leaſt ditto	29,62				
	4	Greateſt ditto			72,0	68,0	
	15	Leaſt ditto			64,0		

Meteorological Obſervations at Caën in Normandy.

1767

Months	Days	Barometer	Inches	Mean	The.	Mean	Remarks
October	15	Greateſt height	30,16	29.92			Theſe obſervations from the 7th to the 20th only. Wind moſt in the North points, chiefly cloudy, ſome rain.
	8	Leaſt ditto	29,68				
	8	Greateſt ditto			62,0	57,5	
	14	Leaſt ditto			53,0		
November	28	Greateſt ditto	30,37	29,79			Theſe obſervations from 14th to 29th only. Wind chiefly in the S. points; 18th, 21ſt, 22d, ſun-ſhine and ſmall froſt. 16th the leaves ſtill green on the trees.
	15	Leaſt ditto	29,21				
	27	Greateſt ditto			54,0	50,5	
	23	Leaſt ditto			47,0		
December	3	Greateſt ditto	30,44	29,815			23d began to freeze very hard with N. N. E. wind. See an account of this froſt lower down. 1ſt, moſt trees have leaves, but yellow and begin to fall. 13th, the trees ſtripped of their leaves.
	20	Leaſt ditto	29,19				
	8	Greateſt ditto			54,0	43,5	
	27	Leaſt ditto			33,0		

1768

Months	Days	Barometer	Inches	Mean	The.	Mean	Remarks
January	5	Greateſt ditto	30,00	29,55			Wind moſtly in the Eaſt points. 1ſt, much ſnow: high wind; hard froſt to the 8th; 8th, thaws. The reſt of the month rainy and windy.
	8	Leaſt ditto	29 10				
	30	Greateſt ditto			52,5	37,25	
	6 7	Leaſt ditto			22,0		
February	6	Greateſt ditto	30,37	29,965			In the beginning wind in the N. points: at the end in the S. This month moſtly windy, cloudy and rainy.
	10	Leaſt ditto	29,56				
	14 16	Greateſt ditto			57,0	50,5	
	4 5	Leaſt ditto			44,0		

Mete-

Meteorological Obſervations at Caën in Normandy.

1768

Months	Days	Barometer	Inches	Mean	The.	Mean	Remarks
March	4 11 15	Greateſt height Leaſt ditto	30 39 29 02	29 705			Wind chiefly E. towards the N. greateſt part of this month froſty.
	1 11 12	Greateſt ditto Leaſt ditto			57,0 44,0	50,5	
April	11 29	Greateſt ditto Leaſt ditto	30,16 29,43	29,795			Wind changing; 6th, ſtorm of thunder, lightening, and hail, at 5 h. P.M. lightning fell on the church, called Abbaie aux Dames, ran over the choir with quick ſerpentine motion, and then diſappeared without any further miſchief; 29th, rain and thunder at 11h. ½ A. M.
	17 1	Greateſt ditto Leaſt ditto			61,0 51,0	56,0	
May	23 29	Greateſt ditto Leaſt ditto	30,17 29.35	29,76			Wind chiefly in the N. points. This month was windy, and the ſun ſhone with white broken clouds. 5th, at 10 h. P.M. ſtorm of thunder, lightning and rain.
	23 2 19	Greateſt ditto Leaſt ditto			70,0 56,0	63,0	
June	21 26	Greateſt ditto Leaſt ditto	30,16 29,55	29,855			Wind chiefly in the Weſterly points. 7th, at 4 h. P.M. ſtorm of hail thunder and lightning; from 9th to 22d, windy and rainy; 24th, ſtormy, with rain thunder and lightning.
	24 20	Greateſt ditto Leaſt ditto			69,0 62,5	65,8–	
July	21 7	Greateſt ditto Leaſt ditto	30,14 29,55	29,845			Wind chiefly in the Weſterly points. This month cloudy and windy, with ſome rain.
	1 20	Greateſt ditto Leaſt ditto			73,0 65 0	69,0	
Auguſt	9 4	Greateſt ditto Leaſt ditto	30,13 29,96	30,015			Theſe obſervations from the 3d to the 13th only. Wind moſt in the Weſtern points; ſky partly cloudy, partly clear.
	12 9	Greateſt ditto Leaſt ditto			70,0 66,0	68,0	

Mete-

Meteorological Obſervations at Caën in Normandy.

1768.

Months	Days	Barometer	Inches	Mean	The.	Mean	Remarks
September	14 12	Greateſt height Leaſt ditto	30,03 29,45	29.74			Theſe obſervations from the 7th to the 15th only. Wind unſettled. 12th, ſome thunder in the morning; the other days wind, clouds or rain.
	14 8	Greateſt ditto Leaſt ditto			65,0 60,5	62,7+	
October							October 30th, betwixt 12 h. and 13 h. at Harcourt, about 5 leagues S. W. of Caën, ſeveral gentlemen ſaw a ball of fire of a whitiſh colour, apparently of about a foot diameter, which caſt a great light in the room, though the curtains were drawn, and there was a great fire and ſeveral wax lights in it: its direction from N. to S. It fell with great velocity, and ſeemingly about 30 or 40 yards from the room, without any exploſion. I had juſt left the apartment, but was immediately informed of it; about 3 hours after, there was a violent hurricane of wind, hail and rain.
November	19 23	Greateſt ditto Leaſt ditto	30,22 28,60	29,41			Barometer at noon the 21ſt 29,43 ditto — — 22d 28,46 fell in 24 hours 0,97 22d, continued rain; at 10½ P. M. ſmart flaſhes of lightning with thunder. Wind varying this month and the weather cloudy, rainy and windy; 15th leaves begin to fall.
	15 30 23	Greateſt ditto Leaſt ditto			54,0 44,0	49,0	
December	12 2	Greateſt ditto Leeſt ditto	30,40 29,14	29,77			Wind chiefly in the Southern points. 2d ſtorm of wind and rain; 14th hard froſt. The weather this month unſettled.
	1 15	Greateſt ditto Leaſt ditto			52,0 32,0	42,0	

Mete-

Meteorological Obſervations, at Caën in Normandy.

1769.

Months	Days	Barometer	Inches	Mean	The.	Mean	Remarks
January	14	Greateſt height	30,16	29,825			Wind chiefly in the Southern points, cloudy, wind and rain; 24th white froſt; 22d white froſt: the weather this month unſettled.
	1	Leaſt ditto	29,49				
	13	Greateſt ditto			50,0	44,7+	
	22 24	Leaſt ditto			39,5		
February	20	Greateſt ditto	30,19	29,725			Wind moſtly in the Eaſtern points. 4th at 11 h. P. M. hurricane, morning generally white froſt. From the 22d to the end of the month, rainy, cloudy, and high wind.
	5	Leaſt ditto	29,26				
	28	Greateſt ditto			53,0	46,0	
	1	Leaſt ditto			39,0		
March	3	Greateſt ditto	30,47	29,835			Wind in the Northern and Weſt points. All this month clouds and wind; little rain.
	11	Leaſt ditto	29,20				
	4	Greateſt ditto			55,0	50,5	
	10 31	Leaſt ditto			46,0		
April	24	Greateſt ditto	30,13	29,605			Wind at beginning in the North points; at the middle in the South points; at the end in the North points; 22d, white froſt in the morning; the reſt of the month chiefly rainy and windy.
	8	Leaſt ditto	29,08				
	28	Greateſt ditto			62,5	54,2+	
	2.3.4.5.6	Leaſt ditto			46,0		
May	2	Greateſt ditto	30,39	29.945			Wind varying; 18th, at 3 h. P.M. thunder; 20th at 4 h. P.M. rain with thunder and lightning; 23d, at 11 h. P.M. thunder and lightning; 23d, at 3 h. ½ P.M. ther. 75°; 27th, at 4 h. P. M. a very heavy rain. This month moſtly windy and rainy.
	14	Leaſt ditto	29,50				
	23	Greateſt ditto			73,0	63,5	
	13	Leaſt ditto			54,0		
June	11	Greateſt ditto	30,19	29,92			Theſe obſervations from 2d to the 19th only; wind chiefly in the W. points. This month cloudy, windy and rainy.
	15	Leaſt ditto	29,65				
	9.10.13	Greateſt ditto			65,0	63.0	
	15	Leaſt ditto			61,0		

Meteorological Obſervations at Caën in Normandy.

1769.

Month	Days	Barometer	Inches	Mean	Ther.	Mean	Remarks
July	10	Greateſt height	30,16	29,60			Theſe obſervations from 6th to 16th only; wind variable; firſt days clouds; the laſt days clear ſun.
	8	Leaſt ditto	29,04				
	7	Greateſt ditto			76,0	72,5	
	10.	Leaſt ditto			69,0		
Auguſt	18	Greateſt ditto	30,12	29,81			Theſe obſervations from the 14th to the 23d only. Wind chiefly in the Weſt points; clouds and wind.
	22	Leaſt ditto	29,50				
	15	Greateſt ditto			70,0	66,7+	
	21	Leaſt ditto			63,5		
September	16	Greateſt ditto	30,17	29,785			Shifting winds; 9th, at 3h. P. M. a very heavy ſhower of hail from the W. the hailſtones about the ſize of a middling walnut, of different irregular ſhapes; the largeſt of ſome, brought to me after the ſtorm, diminiſhed in volume, and weighed ſtill 2 penny-weights and 2 grains; the ſtorm laſted about 4 or 5 minutes.
	12	Leaſt ditto	29,40				
	6 19	Greateſt ditto			71,0	65,5	
	26	Leaſt ditto			60,0		
October	10	Greateſt ditto	30,30	29,98			Wind variable; weather unſettled; often changing.
	22	Leaſt ditto	29,66				
	19 20	Greateſt ditto			63,0	55,8	
	7	Leaſt ditto			48,6		
November	28	Greateſt ditto	30,52	30,035			Theſe obſervations from 18th to 30th only; wind ſhifting; 19th, 20th, hard froſt; the reſt of the month moſtly wind with ſome rain.
	22 23	Leaſt ditto	29,55				
	27	Greateſt ditto			55,0	47,5	
	20	Leaſt ditto			40,0		
December	4	Greateſt ditto	30,38	29.59			Theſe obſervations from the 3d to 24th only: the wind almoſt always in the South points; wind and rain; 23d, ſqualls at 8h. P. M. the barometer being at 28,69 inches.
	23	Leaſt ditto	28,69				
	23	Greateſt ditto			55,0	49,0	
	8	Leaſt ditto			43,0		

Mete-

Meteorological Observations at Caën in Normandy.

Inches 1765	Mean height of Barometer
29,650	January
29,505	February
29,495	March
29,975	April
29,900	May
30,000	June
29,990	July
29, 66 +	August
	September
29,645	November
29,730	December
29,655	mean of these means
30,375	January 1766
30,065	February
29,565	March
29,875	April
29,885	July
30,065	August
29,990	September
29,555	October
29,992 —	mean of these means
29,575	January 1767
29,665	February
29,860	May
29,770	June
29,825	July
29,890	September
29,920	October
29,790	November
29,815	December
29,790	mean of these means

Inches	Mean height of Barometer.
29,550	January 1768
29 965	February
29,705	March
29,795	April
29,760	May
29,855	June
29,845	July
30,015	August
29,740	September
29,410	November
29,770	December
29,828 +	mean of these means
29,825	January 1769
29,725	February
29,835	March
29,605	April
29 915	May
29,920	June
29,600	July
29,810	August
29,785	September
29,98	October
30,045	November
29,590	December
29,805	mean of these means
Mean height	In the years
29,665	1756
29,922	1766
29,790	1767
29,828 +	1768
29,8[illegible]5	1769
29,802	mean of these means

Remarks

These observations were made at noon, in a South-West room, with a barometer, whose tube is about $\frac{3}{10}$ of an inch diameter; in which the motion of the quicksilver, in squalls and gusts of wind, is extremely perceptible; yet, for further satisfaction, I ordered another to be made in London, with the greatest care, by Heath and Wing, with a nonius giving the $\frac{1}{100}$ part of an inch. I placed this barometer by the other, in July 1769; and having compared them every day for a year, I find that the ancient one marks $\frac{5}{100}$ of an inch more than the other; therefore, if from the mean height as

above —	29,802
be deduced —	0,050
the true mean height is	29,752

The greatest height observed, at noon, was, Jan. 29, 1766, 30,72

The least, Dec. 23, 1769, at 8 h. P. M.

Limits of the motion of quicksilver —	2,03

Hence it appears, that if the mean height of barometers, on a level with the ſurface of the ſea, be ſuppoſed, with Dr. Scheuchzer, Phil. Tranſ. No 405, 406, — 29,993 inches
and the mean height at Caën, — — 29,752 ditto

0,241 the diff.

will be the greater mean weight of the atmoſphere at the ſurface of the ſea, then at Caën: and if, with the Doctor, we allow, for each tenth of an inch depreſſion of the quickſilver, 90 feet elevation, my room, which is in the higheſt part of the town, will be about 217 feet above the level of the ſea.

Monſieur de Luc, of Geneva, has given a method to meaſure the different elevation of places by barometers, grounded on his own obſervations, far more exact than any other before him; his rule is, "the difference of the logarithms of the height of "the quickſilver, in the two places, reduced into French lines, "and the logarithms carried to five places, including the charac- "teriſticks, will give the difference of elevation in toiſes, if "Fahrenheit's thermometer be nearly at 66°; but about $\frac{1}{18}$ muſt "be deducted from the elevation ſo given, if the thermometer "be at 55° or temperate."

29,993 Engliſh inch. = 337,824 French lines log. 25286,8
29,752 ditto = 335,110 ditto log. 25251,9

diff. 34,9 toiſes

or 209 4 French feet = 223 Engliſh feet nearly; from which if $\frac{1}{18}$ = 12 ½ nearly be deducted, 210 ½ feet remain for the difference of elevation of my room and the ſurface of the ſea, which differs 6 ½ feet from the reſult given by the firſt hypotheſis.

The greateſt height obſerved, in theſe five years, with a good Fahrenheit's thermometer ſcreened from the ſun, in a S. W. room, was as follows at noon:

1765 Auguſt 23d }
1766 Auguſt 9th } 76°
1765 June 7th }

the leaſt height of ditto Jan. 6th 1768 — — 14

1765 Auguſt 23, expoſed the thermometer, at noon, to the ſun, ſuſpended on a thread between two ſticks, in the middle of my garden at Caën, which may be about two Engliſh acres, ſo that the thermometer received the leaſt reflected heat poſſible in that place; the quickſilver ſtood as follows,

at

at 1h P. M. 97°
at 2 ditto 96

1765 August 26, at a village, called *les Iles Bardelles*, 7 leagues from Caen, the same thermometer, in a South room, from which the sun was excluded by the window shutters, rose to 90°.

An Account of a remarkable degree of cold observed at Caën in Normandy.

1767	Ther.	Hours	Barometer
December	°	h ′	Inch.
24	+ 12	at 8 0	30,02
	+ 16	at 9 0	30,02
25	+ 18	at 11 0	
	+ 15	at 12 44	
	+ 18	at 21 45	
		at 22 00	29,9 little wind at E. S. E. small fog. cloudy.
26	+ 15	at 10 00	
	+ 11	at 19 00	
	+ 12	at 21 00	
		at 22 00	29,67 wind N. E.
27	+ 17	at 7 00	
	+ 16½	at 8 00	
	+ 12	at 10 00	
	+ 11	at 11 00	
	+ 10	at 18 00	
	+ 10	at 20 00	
		at 22 00	29,49 no wind.
28	+ 15	at 8 20	
	+ 14	at 11 00	
	+ 13	at 19 00	
	+ 18	at 22 00	29,46 little wind S. S. E. flying clouds.
30	+ 23	at 7 00	
	+ 20	at 10 00	
	+ 11	at 19 00	
	+ 14	at 21 00	
		at 22 00	29,84 little wind S. flying clouds

An

An Account of a remarkable degree of cold, obſerved at Caën in Normandy.

1768	Ther.	Hours	Barometer.
January	°	h ′	
3	+ 10	at 11 00	
	+ 9	at 20 00	
4	+ 11	at 5 00	
	+ 10	at 6 00	
	+ 8	at 8 00	
	+ 6	at 9 15	
	O	at 12	
	— 8	at 19 30	
	O	at 21 0	30,03 clear ſky, no wind.
		at 19 0	30,00 wind W. by S.
5	— $2\frac{1}{2}$	at 5 30	
	— 2	at 6 30	
	— 2	at 8 00	
	+ 1	at 9	
	O	at 9 30	
	— 3	at 10 00	
	O	at 10 35	
	O	at 11 00	
	+ 3	at 19 30	
	+ 6	at 20 00	
	+ 7	at 21 00	
	+ 8	at 21 30	
	+ 10	at 22 15	
6	+ 14	at noon	
	+ 12	at 7 15	
	+ 14	at 8 45	
	+ 13	at 10 00	

N. B. The ſign + ſignifies, that the degrees marked by the quickſilver were above o, or the beginning of the diviſion.

The negative ſign — ſignifies, that the degrees were below o, or the beginning of the diviſions.

The thermometer was expoſed in the open air to the North.

The hours are aſtronomical hours.

Experi-

Experiments on ſome Liquids.

1768	H. M.	
Jan. 3	11 30	I placed a wine glaſs half full of rack, another half full of rum, in a North window, to the open air: the next day, at the ſame hour, the rack was frozen to a thick jelly, with icey particles; the rum alſo to a jelly, but leſs thick.
	4 50	I expoſed, as above, a wine glaſs, half full of cyder: ditto of beer.
		Ditto of red wine, called Beaujenci.
	5 13	The cyder began to freeze.
	6 30	Ditto conſolidated.
4	5 5	The beer began to freeze.
	6 30	Ditto conſolidated.
	5 12	The wine began to freeze.
	6 30	Ditto nearly conſolidated.
		The icey ſurface of the cyder being broken, it froze over again, in three or four ſeconds, the ice forming, with a progreſſive motion, very perceptible to the eye.
	9 00	I expoſed, as above, a wine glaſs half full of Malaga wine.
		Half ditto of Burgundy, called Migraine.
		Half ditto of Rouſſillon wine.
		Half ditto of ſpring water.
5		Half ditto of cyder-brandy.
	9 15	The water began to freeze.
	9 30	Ditto conſolidated.
	9 30	The Malaga, Migraine, Rouſſillon, began to freeze.
	11 00	Ditto ditto ditto conſolidated.

N. B.

N. B. The brandy did not freeze; but the 6th at noon, the quantity was diminifhed, and fome icey particles ftuck to the glafs, above the furface of what remained. I found, by weighing the above liquids hydroftatically, in a temperate ftate of heat, that the migraine, cyder, beaujenci, beer, and the water, were very nearly of the fame fpecific gravity; and that a piece of gold, which

weighed in the water	-	-	224,25	grains,
weighed in the Malaga	-	-	224,00	ditto,
in the Rouffillon	-	-	224,50	ditto,
in the brandy	-	-	225,00	ditto.

XXXIII. Nyctanthes elongata, *nova Planta Indica, quam, deſcriptione atque icone illuſtratam, illuſtriſſimæ Societati Regiæ* Londinenſi *reverenter offert* Petrus Jonas Bergius, *M. D.* Suecus, *R. Soc.* Lond. *aliarumque Societ. Membr.*

Read May 9, 1771.

ETSI Botanicis plantarum in India orientali naſcentium multa dudum meſſis fuit, tamen non dubitandum arbitror, quin adhuc ſatis amplus variis locus detur ſpicilegiis. Loquor jam potiſſimum de oris oceano vicinis, quæ plantarum curioſis identidem patuerunt; non de regionibus iſtius terræ ab oceano remotioribus, utpote quæ, a nullo botanico in hunc uſque diem calcatæ, adeo non novarum minuſve cognitarum plantarum offerrent ſpicilegia, ſi cuiquam oculatiori contingeret eas adire, ut potius integram atque abundantem earundem ſine dubio præberent meſſem. Ut autem harum regionum gaza herbaria admodum foret exoptanda ſummoque niſu deſideranda, ita nec illarum exilior forte jam reſidua ſupellex ullatenus eſt contemnenda, quin potius attentis, quoad liceat, oculis conſideranda ab unoquoque, qui contemplatione naturæ, uti par eſt, delectatur.

Ego proinde cupide ac libenter excepi oblatas mihi aliquoties ab amicis, ex itinere Chinenſi reverſis, haud paucas ſtirpes, in diverſis oceani Indici inſulis deprehenſas;

deprehensſas; quas ubi ſtudioſius contemplor, video-euq nonnullas raritate præſtantiſſimas, atque idcirco novas, quod Botanicorum antea innotuerunt nemini, congruens meis puto ſtudiis eas omnes impenſe examinare apteque deſcribere & delineare. Cæterum ne hæcce res juſto diutius duci per alias meas occupationes videatur, occaſionem ſectabor quam potero primam delicias haſce cum orbe erudito communicandi.

Patiatur itaque illuſtriſſima Societas Regia Londinenſis, quod ad acta ipſius nunc illico tranſmittam exactiſſimam iconem idoneamque deſcriptionem novæ cujuſdam plantæ Indicæ, quam ad Nyctantis genus amandare debui, etiamſi illius habitus ſatis abludit a cunctis dudum cognitis Nyctanthis ſpeciebus. Una quidem harum, nempe Nyctanthes multiflora, a Cl. *N. L. Burmanno*, *Flor. Ind. tab.* III. *fig.* 1. delineata, quodammodo cum mea convenit ipſo florum ſitu; ſed tamen valde ab ea diſcrepat, non ſolum florum magnitudine, ſed etiam foliorum figura & reliquo habitu, unde quoque diverſitas ſatis elucet ſpecierum.

Icon adjuncta (Tab. XI.) ramulum refert naturali magnitudine expictum; & vero ramulum ipſum accepi ab amico *C. G. Ekeberg*, ex itinere in Chinam domum non ita pridem feliciter redeunte.

Nyctanthes (*elongata*) foliis cordato-lanceolatis acutis elongatis minoribuſque, ramis teretibus.

Descr. *Caulis* fruticoſus. *Rami* ſubprocumbentes, oppoſiti, teretes, inferiores glabri, ſuperiores villoſi, ramoſi: ramulis oppoſitis. *Folia* oppoſita, cordato-lanceolata, ſubbipollicaria, acuminata, integerrima, utrinque glabra, nervoſa, margine paululum undulata, ſaturate viridia; inferiora ramulorum ſenſim

minora,

minora, infima vero cordato-ovata, parva. *Flores* in ramulis terminales, 5 vel 6 congesti, subumbellati, breviter pedicellati. CALYCIS perianthium monophyllum, tubulatum, minimum, persistens, sex vel septemfidum: laciniis subulatis, pilosis. COROLLA monopetala; *Tubus* cylindricus, striatus, longus, pollicaris, superne incrassatus; *Limbus* planus, octo vel novempartitus: laciniis ovato-oblongis, acutis. STAMINA, *Filamenta* bina, brevia; *Antheræ* lineares, obtusæ, utrinque sulcatæ, intra tubum corollæ occultatæ. PISTLLUM. *Germen* subrotundum, truncatum, retusum, glabrum. *Stylus* filiformis longitudine staminum. *Stigma* incrassatum, bifidum.

XXXIV. *Account of a Mole from* North America: *In a Letter to Dr.* Maty, *Sec. R. S. from the Hon.* Daines Barrington, *F. R. S.*

Dear Sir,

May 15, 1771

Read May 15, 1771.

I Send herewith a mole from North America, which Mr. Kuckahn (who hath before preſented ſeveral birds and inſects to the Society) deſires they will do him the honour to place in their Muſeum.

This ſpecies of mole much reſembles that of Europe in its general appearance, except in point of colour: to ſhew, however, that there is a very material and ſpecific difference between the two animals, I have incloſed the head of the common Engliſh mole, which contains all the teeth belonging to each jaw.

The American ſpecimen is not indeed ſo perfect in this reſpect; but a ſufficient number of teeth remains, to ſhew the diſtinction between theſe two ſorts of moles.

In the European, you will obſerve ſix cutting teeth in the upper jaw, which are followed by two canine ones.

In

In the American (on the other hand) there are two very long and large cutting teeth in the centre, calculated to fill the vacancy in the lower jaw, which contains only two ſhort cutting teeth, followed immediately by two long canine ones.

In the lower jaw of the European mole, however, there are eight ſmall cutting, without the intervention of any canine teeth. I am,

Dear Sir,

Your moſt faithful

humble ſervant,

Daines Barrington.

XXXV. *Letter from the Hon.* Daines Barrington, *F. R. S. to* William Heberden, *M. D. F. R. S. giving an Account of ſome Experiments made in* North Wales, *to aſcertain the different Quantities of Rain, which fell in the ſame Time, at different Heights.*

S I R,

December 24, 1770.

Read June 6, 1771.

AS I happened to be at the meeting of the Royal Society, when your experiments were read, relative to the different quantities of rain, which fell within receivers of the ſame dimenſions at different heights from the ground; it occurred to me, that the ſame trials might be made at more diſproportionate heights, though at the ſame diſtance from the ſurface of the earth.

I accordingly directed two rain-gages of exactly the ſame dimenſions to be made by your inſtrument-maker, which you was ſo obliging as to take the trouble of examining.

As I propoſed to keep them at the top and bottom of a Welch mountain, and am not ſtationary a ſufficient time in the Principality to attend to a long courſe of ſuch obſervations; I ſent the rain-gages to Mr.

Mr. Meredith Hughes, of Bala, in Merionethſhire, who is a very ingenious land-ſurveyor, and, from his philoſophical turn, would be pleaſed with executing the commiſſion, though a very troubleſome one.

I directed him to place one of the rain-gages at the top of Rennig, which is about four miles Weſt of Bala, and is commonly conſidered as the fifth mountain of North Wales, in point of height *.

I directed the other rain-gage to be fixed near a houſe, called Bochyrhaidr, at about half a mile's diſtance from Rennig; and ſo as that the rain might not be impeded, when the wind blew over the mountain towards the point where the lower rain-gage was placed. Proper precautions were alſo taken, that neither cattle, nor any other accident, ſhould interfere with the experiment.

Being deſirous to know with ſome degree of preciſion the height of this mountain, I directed Mr. Hughes to aſcertain it in the common method, by examining the fall of the mercury in the barometer, at the top, when compared with its ſtate at the bottom. Having made this experiment, he informed me, that the difference was one inch and ſixten ths, which according to Dr. Halley's method of computation, would give about 450 yards in height, from the adjacent plain.

By the following table it will appear, that the quantities of rain, which had fallen in the two rain-

* I rather ſuppoſe it, however, to be only the ſixth, and ſhould range them thus, according to their comparative heights: Carnedd Llewelin, Snowdon, Cader Idrys, Arran Mowddy, Glider, and Rennig. I place Carnedd Llewelin before Snowdon, becauſe I carried a water level to the top of the latter, and conceived Carnedd Llewelin to be higher; perhaps the difference may be only a few yards.

gages

gages were weighed ſix ſeveral times; in three of which the contents of the upper receiver exceeded thoſe of the lower; and in the three others, the quantity in the lower exceeded that of the upper. On the whole, however, the contents of the lower rain-gage exceeded that of the upper above half an inch. This trifling difference therefore ſeems to ariſe from a ſhower's laſting perhaps a little longer on the bottom of the mountain, and not from any permanent cauſe, as in your obſervations.

I am perſuaded, that theſe experiments have been made with the greateſt attention and accuracy, as I was at Bala in Auguſt laſt, and found that all my directions had been moſt punctually followed.

The inference to be drawn however from them (ſuch as they are) ſeems to be, that the increaſe of the quantity of rain depends upon its nearer approximation to the earth, and ſcarcely at all upon the comparative height of places, provided the rain-gages are fixed at about the ſame diſtance from the ground.

Poſſibly alſo a much controverted point between the inhabitants of mountains and plains may receive a ſolution from theſe experiments; as in an *adjacent valley, at leaſt*, very nearly the ſame quantity of rain appears to fall within the ſame period of time as upon the neighbouring mountains. I am, Sir,

Your moſt faithful

humble ſervant,

Daines Barrington.

1770.	Bochyraidr. Grains	Inches.	The top of Rennig. Grains.	Inches.
From July 6th to 16th	5080 =	0,709	4643 =	0,648
July 16th to 29th	15654 =	2,185	15217 =	2,124
July 29th to Aug. 10th	4370 =	0,610	4698 =	0,656
Sept. 9th both bottles had run over.				
Sept. 9th to 30th	23167 =	3,234	17648 =	2,464
Oct. 17th both bottles had run over.				
Oct. 17th to 22d	5353 =	0,747	6336 =	0,885
Oct. 22d to 29th	9179 =	1,281	9944 =	1,388
Nov. 20, both bottles were broken by the frost.		8,766		8,165

N O T E.

It may not be improper to subjoin to the foregoing account, that, in the places where it was first observed, that a different quantity of rain would be collected, according, as the rain-gages were placed above or below the tops of the neighbouring buildings, the rain-gage below the top of the house, into which the greater quantity of rain had for several years been found to fall, was above fifteen feet above the level of the other rain-gage, which in another part of London was placed above the top of the house, and into which the lesser quantity always fell. This difference therefore does not, as Mr. Barrington justly remarks, depend upon the greater quantity of atmosphere, through which the rain descends: though this has been supposed by some, who have thence concluded, that this appearance might readily be solved by the accumulation of more drops, in a descent through a greater depth of atmosphere. W. H.

XXXVI. *A Disquisition concerning certain Fluents, which are assignable by the Arcs of the Conic Sections; wherein are investigated some* new *and* useful *Theorems for computing such Fluents: By* John Landen, *F. R. S.*

Read June 6, 1771.

MR. Mac Laurin, in his Treatise of Fluxions, has given sundry very elegant Theorems for computing the Fluents of certain Fluxions by means of Elliptic and Hyperbolic Arcs; and Mr. D'Alembert, in the Memoirs of the Berlin Academy, has made some improvement upon what had been before written on that subject, But some of the Theorems given by those Gentlemen being in part expressed by the difference between an Arc of an Hyperbola and its Tangent, and such difference being not directly attainable, when such Arc and its Tangent both become infinite, as they will do when the *whole* Fluent is wanted, although such Fluent be at the same time finite; those Theorems therefore in that case fail, a computation thereby being then impracticable, without some farther help.

The supplying that defect I considered as a point of some importance in Geometry, and therefore I earnestly

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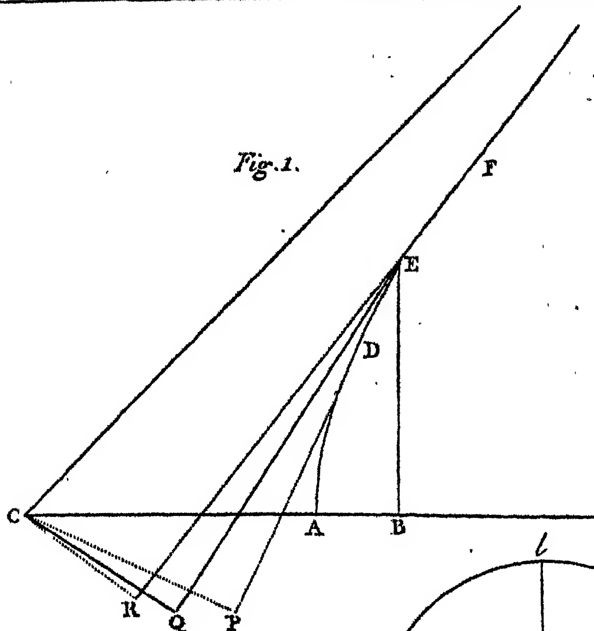

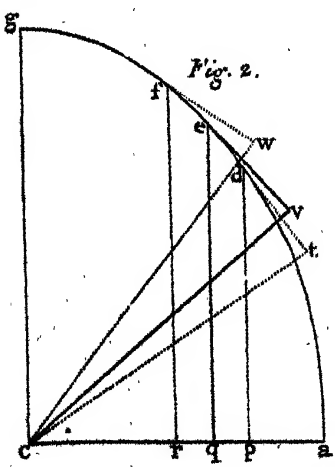

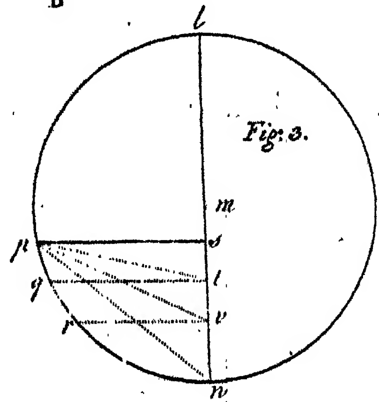

Basire sc.

earneſtly wiſhed, and endeavoured, to accompliſh that buſineſs; my aim being to aſcertain, by means of ſuch arcs, as above-mentioned, the *Limit* of the difference between the Hyperbolic Arc and its Tangent, whilſt the point of contact is ſuppoſed to be carried to an infinite diſtance from the vertex of the curve, ſeeing that, by the help of that *Limit*, the computation would be rendered practicable in the caſe wherein, without ſuch help, the before-mentioned Theorems fail. And having ſucceeded to my ſatisfaction, I preſume, the reſult of my endeavours, which this Paper contains, will not be unacceptable to the Royal Society.

1.

Suppoſe the curve ADEF (Tab. XII. fig. 1.) to be a conic *Hyperbola*, whoſe ſemi-tranſverſe axis AC is $= m$, and ſemi-conjugate $= n$.

Let CP, perpendicular to the tangent DP, be called p; and put $f = \frac{m^2 - n^2}{2m}$, $z = \frac{p^2}{m}$. Then (as is well known) will DP − AD be = the fluent of $\frac{-\frac{1}{2}m^{\frac{1}{2}}z^{\frac{1}{2}}\dot{z}}{\sqrt{n^2 + 2fz - z^2}}$, p and z being each = to m when AD is $= 0$.

2.

Suppoſe the curve adefg (fig. 2.) to be a quadrant of an *Ellipſis*, whoſe ſemi-tranſverſe axis cg is $= \sqrt{m^2 + n^2}$, and ſemi-conjugate ac $= n$. Let

ct be perpendicular to the tangent dt, and let the abscissa cp be $= n \times \left(\frac{z}{m}\right)^{\frac{1}{2}}$. Then will the said tangent dt be $= m \times \left(\frac{mz - z^2}{n^2 + mz}\right)^{\frac{1}{2}}$; and the fluxion thereof will be found

$$= \tfrac{1}{2} mn^2 z^{-\frac{1}{2}} \dot{z} \times \frac{(m - z)^{\frac{1}{2}}}{(n^2 + mz)^{\frac{3}{2}}} - \frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}.$$

3.

In the expression $\frac{y^{q-1} \dot{y}}{(a + by)^r \times (c + dy)^s}$, let $\frac{c + dy}{a + by}$ be supposed $= z$. Then will $\frac{az - c}{d - bz}$ be $= y$, and the proposed expression will be

$$= \frac{(ad - bc)^{1 - r - s} \times z^{-s} \dot{z}}{(az - c)^{1 - q} \times (d - bz)^{1 + q - r - s}}.$$

4.

Taking, in the last article, r and s each $= \frac{1}{2}$, $q = \frac{3}{2}$, $a = -d = \frac{n^2}{m}$, $b = 1$, and $c = n^2$, we have

$$\frac{y^{\frac{1}{2}} \dot{y}}{\left(\frac{n^2}{m} + y\right)^{\frac{1}{2}} \times \left(n^2 - \frac{n^2}{m} y\right)^{\frac{1}{2}}} \left(= \frac{m^{\frac{1}{2}} n^{-1} y^{\frac{1}{2}} \dot{y}}{\sqrt{n^2 + 2fy - y^2}} \right)$$

$$= - mnz^{-\frac{1}{2}} \dot{z} \times \frac{(m - z)^{\frac{1}{2}}}{(n^2 + mz)^{\frac{3}{2}}}.$$

It

It appears therefore, that, y being $= n^2 \times \frac{m - z}{n^2 + mz}$,

$$-\frac{\frac{1}{2} m^{\frac{1}{2}} y^{\frac{1}{2}} \dot{y}}{\sqrt{n^2 + 2fy - y^2}} - \frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}} \text{ is}$$

$$\tfrac{1}{2} m n^2 z^{-\frac{1}{2}} \dot{z} \times \frac{\overline{m - z}|^{\frac{1}{2}}}{\overline{n^2 + mz}|^{\frac{3}{2}}} - \frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}},$$

which, by Art. 2. is = the *fluxion of the tang.* d t.

Consequently, taking the fluents, by Art. 1. and correcting them properly, we find

DP — AD + FR — AF = L + d t.

CP, in fig. 1. being $= m^{\frac{1}{2}} z^{\frac{1}{2}}$; cp, in fig. 2. $= n \times \overline{\frac{z}{m}}|^{\frac{1}{2}}$;

CR, perpendicular to the tangent FR $= m^{\frac{1}{2}} y^{\frac{1}{2}}$;

DP — AD = the *fluent* of $\frac{-\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$;

FR — AF = the fluent of $\frac{-\frac{1}{2} m^{\frac{1}{2}} y^{\frac{1}{2}} \dot{y}}{\sqrt{n^2 + 2fy - y^2}}$;

and L the *Limit* to which the difference DP — AD, or FR — AF, approaches, upon carrying the point D, or F, from the vertex A *ad infinitum*.

5.

Suppose y equal to z, and that the points D and F then coincide in E, the points d and p being at the same time in e and q respectively. Then cv being perpendicular to the tangent ev, that tangent will be a *maximum* and equal to cg — ac $= \sqrt{m^2 + n^2} - n$; the tangent EQ (in the hyperbola) will be $= \sqrt{m^2 + n^2}$;

the

the abscissa BC $= m\sqrt{1 + \frac{n}{\sqrt{m^2+n^2}}}$; the ordinate BE $= n \times \sqrt{\frac{n}{\sqrt{m^2+n^2}}}$; and it appears, that L is $= 2\text{EQ} - 2\text{AE} - ev = n + \sqrt{m^2+n^2} - 2\,\text{AE}$! Thus the *Limit* which I proposed to ascertain is investigated, m and n being any right lines whatever!

6.

The *whole fluent* of $\frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$, generated whilst z from o becomes $= m$, being equal to L; and the fluent of the same fluxion (supposing it to begin when z begins) being in general equal to $L + \text{AD} - \text{DP} = \text{FR} - \text{AF} - dt$; it appears, that, k being the value of z corresponding to the fluent $L + \text{AD} - \text{DP}$, $\frac{mn^2 - n^2k}{n^2 + mk}$ will be the value of z corresponding to the fluent $L + \text{AF} - \text{FR}$, and $\text{FR} - \text{AF}$ will be the part generated whilst z from $\frac{mn^2 - n^2k}{n^2 + mk}$ becomes $= m$. It follows therefore, that the *tang.* dt, together with the fluent of $\frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$ generated whilst z from o becomes equal to any quantity k, is equal to the fluent of the same fluxion generated whilst z from $\frac{mn^2 - n^2k}{n^2 + mk}$ becomes $= m$; op being taken $= n \times \left.\frac{k}{m}\right]^{\frac{1}{2}}$.

Suppose

Suppose $k = \frac{mn^2 - n^2 k}{n^2 + mk}$, its value will then be $\frac{n}{m}\sqrt{m^2 + n^2} - \frac{n^2}{m}$. Consequently the fluent of $\frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$ generated whilst z from o becomes $= \frac{n}{m}\sqrt{m^2 + n^2} - \frac{n^2}{m}$, together with the quantity $\sqrt{m^2 + n^2} - n$, is equal to the fluent of the same fluxion generated whilst z from $\frac{n}{m}\sqrt{m^2 + n^2} - \frac{n^2}{m}$ becomes $= m$: and these two parts of the *whole fluent* being denoted by M and N respectively; M will be $= n -$ AE, and N $= \sqrt{m^2 + n^2} -$ AE.

7.

The fluent of $\frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$ being $L +$ AD $-$ DP, the fluent of $\frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}} +$ DP $-$ AD $- L$ will be $= o$. Therefore, the fluent of $\frac{\frac{1}{2} m^{\frac{1}{2}} z^{\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}} +$ the fluent of $\frac{\frac{1}{2} m^{-\frac{1}{2}} n^2 z^{-\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$ being $=$ the fluent of $\frac{1}{2} z^{-\frac{1}{2}} \dot{z} \times \overline{\frac{n^2 + mz}{m - z}}\Big|^{\frac{1}{2}}$, it is obvious, that the fluent of $\frac{\frac{1}{2} m^{-\frac{1}{2}} n^2 z^{-\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$ is $=$ DP $-$ AD $- L +$ the fluent of $\frac{1}{2} z^{-\frac{1}{2}} \dot{z} \times \overline{\frac{n^2 + mz}{m - z}}\Big|^{\frac{1}{2}}$

$=$ DP

$= DP - AD - L +$ the *elliptic arc* dg (fig. 2.) whose abscissa cp is $= n \times \overline{\frac{z}{m}}\big|^{\frac{1}{2}}$.

Consequently, putting E for $\frac{1}{4}$ of the periphery of that ellipsis, it appears that the *whole fluent* of $\frac{\frac{1}{2} m^{-\frac{1}{2}} n^2 z^{-\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$, generated whilst z from o becomes $= m$, is equal to $E - L = E + 2AE - n - \sqrt{m^2 + n^2}$.

8.

By taking, in Art. 3. q, r, and s, each $= \frac{1}{2}$; and $a = - d = \frac{n^2}{m}$, $b = 1$, and $c = n^2$; we find, that, if y be $= \frac{mn^2 - n^2 z}{n^2 + mz}$, $\frac{z^{-\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}} + \frac{y^{-\frac{1}{2}} \dot{y}}{\sqrt{n^2 + 2fy - y^2}}$ will be $= o$.

It is obvious therefore, that the fluent of $\frac{z^{-\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$, generated whilst z from o becomes equal to any quantity k, is equal to the fluent of the same fluxion, generated whilst z from $\frac{mn^2 - n^2 k}{n^2 + mk}$ becomes $= m$.

Now, supposing $k = \frac{mn^2 - n^2 k}{n^2 + mk}$, its value will be $\frac{n}{m}\sqrt{m^2 + n^2} - \frac{n^2}{m}$.

Consequently, the fluent of $\frac{z^{-\frac{1}{2}} \dot{z}}{\sqrt{n^2 + 2fz - z^2}}$, generated whilst z from o becomes $= \frac{n}{m}\sqrt{m^2 + n^2} - \frac{n^2}{m}$,

is

is equal to *half* the fluent of the same fluxion, generated whilst z from o becomes $= m$; which *half fluent* is known by the preceding article.

9.

It appears, by Ar. 4. that

$\frac{\frac{1}{2}m^{\frac{1}{2}}y^{\frac{1}{2}}\dot{y}}{\sqrt{n^4+2fy-y^2}} + \frac{\frac{1}{2}m^{\frac{1}{2}}z^{\frac{1}{2}}\dot{z}}{\sqrt{n^4+2fz-z^2}}$ is $=$ —the *flux. of the tang.* $\dot{d}t$;

and it appears, by the last article, that

$$\frac{\frac{1}{2}m^{-\frac{1}{2}}n^2y^{-\frac{1}{2}}\dot{y}}{\sqrt{n^4+2fy-y^2}} + \frac{\frac{1}{2}m^{-\frac{1}{2}}n^2z^{-\frac{1}{2}}\dot{z}}{\sqrt{n^4+2fz-z^2}} \text{ is } = o;$$

$mn^2 - n^2y - n^2z - myz$ being $= o$.

Therefore, by addition, we have

$$\tfrac{1}{2}y^{-\frac{1}{2}}\dot{y} \times \overline{\frac{n^2+my}{m-y}}\Big|^{\frac{1}{2}} + \tfrac{1}{2}z^{-\frac{1}{2}}\dot{z} \times \overline{\frac{n^2+mz}{m-z}}\Big|^{\frac{1}{2}}$$

$=$ — the *fluxion of the tangent* $\dot{d}t$.

Consequently, by taking the correct fluents, we find the *tang.* $\dot{d}t$ ($=$ the *tang.* fw) $=$ the *arc* $\dot{a}d$ — the *arc* fg! the abscissa cp being $= n \times \overline{\frac{z}{m}}\Big|^{\frac{1}{4}}$, the abscissa $\dot{c}r = n \times \overline{\frac{y}{m}}\Big|^{\frac{1}{4}}$, and their relation expressed by the equation $n^6 - n^4u^2 - n^4v^2 - m^2u^2v^2 = o$, u and v being put for cp and cr respectively. Moreover, the tangents dt, fw, will each be $= \frac{m^2uv}{n^4}$; and $ct \times cw = \overline{cv}^2 = ac \times cg$.

If for the semi-transverse axis cg we substitute h nstead of $\sqrt{m^2+n^2}$, the relation of u to v will be

expreſſed by the equation

$n^6 - n^4u^2 - n^4v^2 - \overline{b^2 - n^2} \times u^2v^2 = o$, and

$\dot{d}\dot{t}$ ($= \dot{f}\dot{w}$) will be $= \frac{b^2 - n^2}{n^3} \times uv$.

If u and v be reſpectively put for fr and dp, their relation will be expreſſed by the equation

$b^6 - b^4u^2 - b^4v^2 + \overline{b^2 - n^2} \times u^2v^2 = o$, and

$\dot{d}\dot{t}$ ($= \dot{f}\dot{w}$) will be $= \frac{b^2 - n^2}{b^3} \times uv$.

10.

Suppoſe $y =$ to z, (that is, $v = u$) and that the points d and f coincide in e. In which caſe the tangent dt will be a *maximum*, and $=$ cg $-$ ac. It appears then that the *arc* ae $-$ the *arc* eg is $=$ cg $-$ ac.

Conſequently, putting E for the quadrantal arc ag, we find that the *arc* ae is $= \frac{E + b - n}{2}$;

the *arc* eg $= \frac{E - b + n}{2}$!

There are, I am aware, ſome other parts of the *arc* ag, whoſe lengths may be aſſigned by means of the whole length (ag) with right lines; but to inveſtigate ſuch other parts is not to my preſent purpoſe.

11.

Taking m and n each $= 1$; that is, ac ($=$ AC) $= 1$, and cg $= \sqrt{2}$; let the arc ag be then ex-

 preſſed

preffed by e: put c for $\frac{1}{4}$ of the periphery of the circle whofe radius is 1; and let the *whole fluents* of $\frac{\frac{1}{2}z^{\frac{1}{2}}\dot{z}}{\sqrt{1-z^2}}$ and $\frac{\frac{1}{2}z^{-\frac{1}{2}}\dot{z}}{\sqrt{1-z^2}}$, generated whilft z from o becomes $=1$, be denoted by F and G refpectively. Then, by what is faid above, $F+G$ will be $=e$; and, by my theorem for comparing curvilineal areas, or fluents, publifhed in the *Philof. Tranfact.* for the year 1768, it appears that $F \times G$ is $=\frac{1}{2}c$. From which equations we find $F=\frac{1}{2}e-\frac{1}{2}\sqrt{e^2-2c}$, and $G=\frac{1}{2}e+\frac{1}{2}\sqrt{e^2-2c}$.

But m and n being each $=1$, L is $=$ F; therefore $1+\sqrt{2}-2AE$, the value of L, from Art. 5. is, in this cafe, $=\frac{1}{2}e-\frac{1}{2}\sqrt{e^2-2c}$. Confequently, in the *equilateral hyperbola*, the *arc* AE, whofe abfciffa BC is $=\sqrt{1+\frac{1}{\sqrt{2}}}$, will be $=\frac{1}{2}+\frac{1}{\sqrt{2}}-\frac{1}{4}e+\frac{1}{4}\sqrt{e^2-2c}$, by what is faid in the article laft mentioned. Hence the *rectification* of *that arc* may be effected by means of the *circle* and *ellipfis!*

The application of thefe *Improvements* will be eafily made by the intelligent Reader, who is acquainted with what has been before written on the fubject. But there is a theorem (demonftrable by what is proved in Art. 8.) fo remarkable, that I cannot conclude this difquifition without taking notice of it.

12.

Let $lpqn$ (fig. 3.) be a circle perpendicular to the horizon. whose highest point is l, lowest n, and center m: let p and q be any points in the semi-circumference $lpqn$: draw ps, qt parallel to the horizon, intersecting lmn in s and t; and, having joined lp, pt, make the angle lpv equal to ltp, and draw rv parallel to qt, intersecting the circle in r, and the diameter lmn in v. Let a pendulum, or other heavy body, descend by its gravity from p along the arc $pqrn$: the body so descending will pass over the arc pq exactly in the same time as it will pass over the arc rn; and therefore, qt and rv coinciding when lt is equal to lp, it is evident that the time of descent from p to q will then be precisely equal to *half* the time of descent from p to n!

And it is farther observable, that, if pqn be a quadrant; the *whole* time of descent will be

$$= \left.\frac{a}{b}\right)^{\frac{1}{2}} \times \sqrt{\tfrac{1}{2}c + \tfrac{1}{2}\sqrt{c^2 - 2c}};$$

the radius lm, or mn, being $= a$; and b being put (for $16\frac{1}{12}$ feet) the space a heavy body descending freely from rest falls through in one second of time.

In general, ns being denoted by d, and the distance of the body from the line ps, in its descent, by x, the fluxion of the time of descent will be expressed by

$$\frac{\tfrac{1}{2} a b^{-\frac{1}{2}} x^{-\frac{1}{2}} \dot{x}}{\sqrt{2ad - d^2 - \overline{2a - 2d} \,.\, x - x^2}};$$

the fluent whereof, corresponding to any value of x, may be obtained by Art. 7. By which article it appears, that the *whole* time

time of deſcent from any point p will be

$$= \frac{a}{b^{\frac{1}{2}} d^{\frac{1}{2}} \times \overline{2a - d}} \times \overline{E + 2AE - pn - ps}.$$

The ſemi-tranſverſe AC (fig. 1.) being $= ns$;
the ſemi-tranſverſe cg (fig. 2.) $= np$;
and the ſemi-conjugate in each figure $= ps$.

Since writing the above, I have diſcovered a general theorem for the rectification of the Hyperbola, by means of two Ellipſes; the inveſtigation whereof I purpoſe to make the ſubject of another Paper.

XXXVII. *A Letter from Mr.* John Reinhold Forſter, *F. A. S. to the Hon.* Daines Barrington, *Vice-Preſ. R. S. on the Management of Carp in* Poliſh Pruſſia.

Somerſet-houſe Stable-yard, May 29, 1771.

DEAR SIR,

Read June 13, 1771.

YOU was ſo kind as to judge favourably of the few hints I threw out in a converſation, about *the management of Carp* in Pruſſia and in the electorates of Brandenburg and Saxony, and deſired me to collect my obſervations upon that ſubject, into a ſmall memoire. Though I am very ſenſible, that there are many more capable of giving a ſatisfactory account of the management of carp; I will, however, to obey your friendly commands, communicate to you ſuch obſervations as I can collect from my own experience; from the methods obſerved in Pruſſia, Brandenburg, and Saxony, where I had opportunities to enquire into the ſubject, during my ſtay in theſe countries; and laſtly, from the inſtructions of an anonymous German patriot, in a book, intitled, *A Syſtem of all the Sciences relative to Oeconomy and the Finances.* In caſe you find theſe obſer-

observations deserving to be laid before the Royal Society, I shall think myself very much honoured by it.

I am, with the sincerest sentiments of gratitude and regard,

DEAR SIR,

Your much obliged humble servant,

John Reinhold Forster.

Observations on the best way of managing Carp, from real experience, and the best methods now in use.

IT would be needless to speak of the natural history of this well-flavoured fish, after the satisfactory account given of it in the *British Zoology* *, by that most accurate zoologist Mr. Pennant. I will only observe this, that though the carp is now commonly found in ponds and rivers, and generally thought to be a fresh-water fish †, the ancient zoologists ranged

* British Zool. Vol. III. p. 300, &c.

† I have great reason to think, that many other fish, which, it is commonly conceived, can only live in the sea, may also exist, at least for several years, and perhaps breed, in fresh water.

the

the ſame among the ſea-fiſh: and I know inſtances of its being caught in the harbour of Dantzig, between that city and a little town called Hela; which

The ſmelt or ſparling (Salmo Eperlanus Linnæi) never comes up our rivers, but for a ſhort time; and then does not penetrate much further than where the water continues to be brackiſh.

I have, however, been informed by Sir Francis Barnard (the late Governor of New England) that in a large pool which he rented not far from Boſton, and which had not the leaſt communication with the ſea, ſeveral of theſe fiſh, originally introduced from the ſalt water, had lived many years, and were, to all appearance, very healthy.

I have alſo the following well-atteſted fact with regard to the common grey mullet, which it is believed was never before taken in freſh water.

Mr. Kymer hath made, near Kidwelly in Carmarthenſhire, a communication between his collieries and an arm of the ſea, by means of a canal.

Before this canal was compleated, the ſalt water filled it at every tide, and ſeveral mullets were by this means introduced.

For theſe three or four years, the ſea hath been entirely excluded; and the canal, from the conſtant influx of freſh water, hath ceaſed to be brackiſh for more than two years.

The mullets, however, continue to live in this canal; though Mr. Kymer informs me, they do not look in ſo good condition, as when freſh from the ſea.

We are ſo much in the dark about the natural hiſtory of fiſh, particularly thoſe of the ſalt water, that it is to be wiſhed ſea ſtews were made on ſome of our coaſts, as I am told is very commonly practiſed in North America, and for a very trifling expence.

Nothing more is requiſite, than either to find or dig a proper cavity, perhaps a yard below the low water mark, at ſpring tides, from which the ſea ſhould be excluded, except at a narrow entrance, where large ſtones ſhould be piled from the beach to above the high water mark.

Through ſuch an inlet, the ſtew would be every twelve hours, ſupplied with freſh ſalt water, at the ſame time that the fiſh would not be able to make their eſcape.

 is

is ſituated at the extremity of a long, narrow, ſandy promontory, projecting Eaſtwards into the ſea, and forming the gulf before Dantzig, of about 30 Engliſh miles diameter. Theſe carp were forced, as I ſuppoſe, by a ſtorm, from the mouth of the Viſtula, which here enters the Baltic, into the ſea: and as the other two branches of the Viſtula or Weixel diſembogue into a large freſh water lake, called the Triſh-Haff, which has a communication with the ſea at Pillau; it is equally probable, that theſe fiſh came round from Pillau, to the harbour of Dantzig; eſpecially as they are frequently found in the Triſh-Haff.

The ſale of carp makes a part of the revenue of the nobility and gentry in Pruſſia, Pomerania, Brandenburgh, Saxony, Bohemia, Mecklenburgh, and Holſtein; and the way of managing this uſeful fiſh is therefore reduced in theſe countries into a kind of ſyſtem, built on a great number of experiments, made during ſeveral generations, in the families of gentlemen well ſkilled in every branch of huſbandry.

The firſt thing which muſt be attended to, in caſe a gentleman chooſes to have carp-ponds, is to ſelect the ground where they are to be made:

By this very eaſily-contrived reſervoir, ſea-fiſh, when caught in too great numbers, might be kept for the ſupply of the table or market, when perhaps the weather will not permit them to be taken; and many ingenious experiments might be tried.

It is not impoſſible (for example) that the fiſh of the freſh water might be improved, by continuing in ſuch a ſtew for a fortnight or three weeks, as horſes are ſaid to thrive by feeding on the ſalt marſhes.

Daines Barrington.

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for upon the ſoil, water, and ſituation of a pond, the ſucceſs in the management greatly depends. The beſt kind of ponds ought to be ſituated in a well-manured, fertile plain, ſurrounded by the fineſt paſtures and corn fields of a rich black mould, having either mild or ſoft ſprings on the ſpot, or a rivulet that runs through the plain; the water ought to be mild and ſoft, by no means too cold, or impregnated with acid, calcareous, ſelenitic, or other mineral particles. The expoſure muſt be ſheltered againſt the cold blaſting Eaſterly or Northern winds, by a ridge of hills, ſituated at ſome diſtance from the pond, enjoying fully the benign influence of the ſun, far from any thick ſhady wood, that might intercept the beams of the ſun, or where the leaves of trees might cauſe a putrefaction, or impregnate the water with aſtringent particles.

Such ponds as are ſurrounded by poor, cold, and ſtiff ſoils, are open to the Eaſt and North winds, have a wood on one or two ſides, and hard or cold water, or ſuch as iſſues from mines, moors, or moſſes, are inferior in goodneſs.

Ponds in a poor, dry, or ſandy ſoil, ſurrounded by pines or firs, with the juſt-mentioned inconveniences, are conſidered as the worſt of all.

The ground towards the pond ought to have a gentle ſlope; for deep vallies are ſubject to great floods, and will then endanger the dikes in a wet rainy ſeaſon; and often the expectations of many years are carried away.

The ſoil cannot be altered; it is therefore a chief qualification of a pond, to be contrived in a good ſoil.

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The ſun is a leſs material article; provided therefore a pond can enjoy the morning and noon-tide ſun, it matters not much if the wood be on one or two of its ſides.

The water is a material point; but in caſe the ſprings that ſupply the ponds are very cold and hard, it may be ſoftened and tempered by expoſing it to the ſun and air in a large reſervoir above the pond, or by leading it for a long way in an open expoſure, before it enters the pond.

The quantity of water to ſupply the pond with, is another requiſite; too much water makes too great a canal neceſſary, for carrying its ſuperfluity off; and this is very expenſive: too little water has another inconvenience, *viz.* that of keeping the water too long in the pond, and to cauſe a ſtagnation, without any ſufficient freſh ſupplies; and often, in a dry ſeaſon, the ſcantineſs of freſh water diſtreſſes the fiſh, and cauſes diſeaſes and mortality among them.

The above remarks are general, and muſt be applied to all kinds of ponds; but now I will enter into a more minute detail: it is found by experience moſt convenient, to have three kinds of ponds for carp. The firſt is called the ſpawning-pond; the nurſery is the ſecond; and the main-pond is the third and largeſt.

There are two methods for ſtocking the ponds with carp; either to buy a few old fiſh, and to put them into a ſpawning-pond; or to purchaſe a good quantity of one year's old fry, for the nurſery. I will treat of both methods, and will add ſomething about the management of carp in the main-pond.

A pond intended for ſpawning, muſt be well cleaned of all other kinds of fiſh, eſpecially ſuch as are of a rapacious nature, *viz.* pike, pearch, eel, and trout; and alſo of all the newts or *larvæ* of lizards, and the *dytiſci* or water-beetles, which frequently deſtroy quantities of the fry, to the great loſs of the owner.

A rich ſoil, gentle ſloping banks, mild ſprings, or a conſtant ſupply of good ſoft water, with a fine expoſure in regard to ſun and air, are the chief requiſites for a good ſpawning-pond.

A pond of the ſize of about one acre, requires three or four male carp, and ſix or eight female ones; and thus further, in proportion to each acre, the ſame number of males and females.

The beſt carp for breeders are five, ſix, or ſeven years old, in good health, in full ſcale, without any blemiſh or wound (eſpecially ſuch as are cauſed by the *lernæa cyprini* Linn. a kind of cartilaginous worm) with fine full eyes and a long body. Such as are ſickly, move not briſkly, have ſpots as if they had the ſmall-pox, have either loſt their ſcales, or have them ſticking but looſely to the body; whoſe eyes lie deep in their heads, are ſhort, deep, and lean, will never produce good breed.

Being provided with a ſet of ſuch carp as are here deſcribed, and ſufficient to ſtock a pond with, it is beſt to put them, on a fine calm day, the latter end of March or in April, into the ſpawning-pond. Care muſt be taken, that the fiſh be not too much hurt by being tranſported in a hogſhead; nor put into the pond on a ſtormy day; for they are eaſily thrown

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upon the ſhallows on the ſides, being weak and harraſſed by being caught, removed, and not yet acquainted with the deep holes for their retreat, in the new habitation.

Carp ſpawn in May, June, or July, according as the warm ſeaſon ſets in earlier or later. The warm weather expands and ſwells gently the bodies of the fiſh; and their bellies being diſtended with roe and milt, they feel an itching about thoſe turgid parts, and therefore ſwim to a ſhallow, warm, ſheltered place, where the bottom of the pond is either ſomewhat ſandy or gritty, where ſome graſs and aquatic plants grow, or where ſome ozier branches and roots hang in the water; they gently rub their bodies againſt the ground, the graſs, or oziers, and by this preſſure, the ſpawn iſſues out; and as the milter, by a natural inſtinct, follows the ſpawner, and feels the ſame itching, the calls of nature are gratified in the ſame manner, and the ſoft roe or milt is ſpread over the ſpawn, and thus impregnated. Carp in this ſeaſon are frequently ſeen ſwimming, as if it were in a circle, about the ſame ſpot, which is merely done with an intention of repeating the rubbing of their expanded bellies. The fineſt and calmeſt ſummer days are commonly thoſe on which carp ſpawn; providence having thus made a proviſion for the greater ſecurity of the fry of ſo uſeful a fiſh; as otherwiſe, in a ſtormy day, the ſpawn would be waſhed towards the banks, where it would be eaten up by birds, or trampled upon by men and quadrupeds, or dried up by the heat of the ſun, and a whole generation of carp entirely deſtroyed. In a pond of my uncle's, I frequently found the carp in a warm ſummer evening, round a

large

large ſtone, rubbing their bellies againſt the hard ſandy ground; I often approached with as much ſilence as poſſible, put my hands and feet among the ſporting carp, and had the ſatisfaction to ſee them paſs and repaſs through my hands, without being in the leaſt diſturbed; but at the leaſt noiſe or quick motion occaſioned by me, they moved away with ſurprizing velocity.

About the ſpawning ſeaſon, great care muſt be taken, to keep out all aquatic fowl, wild and tame, from the ponds; for geeſe and ducks not only ſwallow the ſpawn, but deſtroy ſtill more of it, by ſearching the weeds and aquatic plants. It is therefore a general rule, to ſend twice a day, a man round the ponds, to ſcare all wild fowl, *viz.* ſwans, geeſe, ducks, cranes, and herons.

Sometimes cruſians and carp, or tench and carp, being put together in a pond, and the males and females of each kind not being in a juſt proportion one to another, the different ſpecies mix their roe and milt, and thus produce mules or mongrel breeds.

The mules, between carp and cruſians*, ſeldom and ſlowly attain the ſize, which carp are capable of;

* The fiſh thus named is ſuppoſed to be the ſame with the rud or finſcale (See Br. Zool. Vol. III. p. 310.). It is not very common in England, and is generally eſteemed to be much inferior to a carp in point of flavour, which I rather conceive to ariſe from its being placed in improper ponds, or eaten when it is not fully in ſeaſon, as our countryman Mr. Henſhaw gives the following account of the karouſſe (*cyprinus carauſius* of Linnæus). "The crawfiſh of that country (meaning Denmark) are at leaſt twice as big as ours, and are excellent meat; but the choiceſt pond fiſh they have, is called *karouſs*,

they

they are very deep, and ſhorter in proportion than carp, but of a very hardy nature.

The mules between carp and tench, partake of the nature of both fiſh, come to a good ſize; but ſome part of their body is covered with the ſmall ſlimy ſcales of a tench, and ſome other part has the larger ſcales of carp; their fleſh approaches nearer to that of a tench, and they are likewiſe of a leſs tender nature than the common carp: this latter kind of mule is called in Germany *ſpiegel-karpe*, i.e. the *mirror-carp*, the blotches with large ſcales among the ſmaller ones being conſidered as mirrors.

Whether theſe mules are capable of propagating their ſpecies, I cannot affirm; never having made any experiments on that ſubject; nor have I heard any thing ſaid on that head with any degree of preciſion, or founded on experience. In ſome ponds in Lancaſhire, I was told, by a gentleman of great worth and honour, both theſe kinds of mules are now and then found.

I think it, however, not adviſeable, to put carp and tench, or carp and cruſians, in one pond, unleſs it be done for experiment's ſake; in which latter caſe, a ſmall pond, free from other fiſh, with one or two fiſh of each kind, will be ſufficient to gratify curioſity, without debaſing a generation of carp in a large pond.

"ſomewhat reſembling a roach, with his red fins; but it is "near as big as the largeſt carp, and much better meat."

Dr. Birch's Hiſt. R. S. Vol. III. p. 187.

D. B.

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The young fry being hatched from the ſpawn, by the benign influence of the ſun, they are left the whole ſummer, and even the next winter, in the ſpawning-pond, in caſe the pond be ſo deep, that the ſuffocation of the young tender fry under the ice in a ſevere winter, is not to be apprehended, for it is by no means advantageous to take them out in the firſt months of their exiſtence. However, if the ſhallowneſs of the pond, its cold ſituation and climate, make it neceſſary to ſecure the fry againſt the rigours of the enſuing winter, the water of the pond muſt be let off; the fry and old fiſh will gradually retire to the canal and ditches, which communicate with the hole in the middle of the pond, and a net, with ſmall meſhes, is then employed to catch both the fry and old ones. The old breeders are then ſeparated from the fry, and both kinds put in ſeparate ponds, that are warmer and more convenient for the wintering of theſe delicate fiſh. Care muſt be taken, to fix upon a calm, mild day, at the latter end of September, for the catching of the fry out of the ſpawning-pond.

The nurſeries are the ſecond kind of ponds intended for the bringing up the young fry. The beſt time to put them into the nurſery is in March or April, on a fine and calm day. A thouſand or twelve hundred of this fry may be allotted to each acre of a pond. The choice of the fry muſt be made according to the above enumerated characters of good and healthy fiſh, and muſt be carefully removed from one pond to another It is likewiſe requiſite to ſend people with long ſticks, all the firſt day, round the pond, in order to drive the tender and weak fry from the ſides into the pond, becauſe they are be-

wildered in a ſtrange place, and often become the prey of rapacious birds *.

In caſe the pond be good, and not overſtocked before, and the fry well-choſen and preſerved, it is almoſt certain, they will grow within two ſummers ſo much as to weigh four, five, and ſometimes ſix pounds, and to be fleſhy and well-taſted. A great many Pruſſian gentlemen make a good profit, by ſelling their carp, after two years ſtanding in the nurſery, and export them even to Finland and Ruſſia.

The main-ponds are the laſt kind. In theſe, carp are put, that meaſure a foot, head and tail incluſive. Every ſquare of fifteen feet in the pond is ſufficient for one carp, and will afford food and room for the fiſh to play in. The more room carp have, and conſequently the more food the pond affords, the quicker will be the growth of the fiſh. The longer the pond has been already in uſe, the longer you intend to keep the carp in it, the more you deſire to quicken the growth of them, the more you ought to leſſen the number of fiſh deſtined for the pond. Spring and autumn are the beſt ſeaſons for ſtocking your main-ponds. The growth of your fiſh will always be in proportion with the food they have: for carp are obſerved to grow a long time, and to come to a very conſiderable ſize, and a remarkable weight. I recollect to have ſeen carp above a yard long, and of 25 pounds weight; but I

* I have reaſon to think that the common carrion crow ſhould be added to the liſt of birds, which Mr. Forſter hath before ſuppoſed deſtroy fiſh when in ſhallow waters, as I once ſaw this bird taken by a trap, which was baited with a fiſh for a heron.

D. B.

had no opportunity to aſcertain their real age. In the pond at Charlottenburg, a palace belonging to the king of Pruſſia, I ſaw more than two or three hundred carp between two and three feet long; and I was told by the keeper, they were between 50 and 60 years ſtanding: they were tame, and came to the ſhore in order to be fed; they ſwallowed with eaſe a piece of white bread, of the ſize of half a half-penny roll.

During winter, ponds ought to have their full complement of water; for the deeper the water is, the warmer lies the fiſh. In caſe the pond be covered with ice, every day ſome holes muſt be opened, for the admiſſion of freſh air into the pond, for want of which frequently carp periſh.

In the ſummer, obſerve to clean the rails and wire-works, in the water-courſes, of the weeds and graſs, which frequently ſtop them up. Birds that feed on fiſh muſt be carefully kept out of the ponds. In a great drought, proviſion ought to be made, to keep the water at the ſame height as it commonly ſtands in the pond, *i. e.* between four and five feet. If the water ſtagnates and grows putrid, it muſt be let off, and a ſupply of freſh water be introduced from the reſervoirs. If the weeds, eſpecially reed and flags, and ſome of the aquatic graſſes, over-run too much the pond, ſcithes fixed on poles of 16 or 20 feet, with a lead faſtened to them to keep the ſcithes on the bottom of the pond, are thrown out, and then again drawn to the perſon that works with them, and the weeds will all be cut; after which operation, they muſt be drawn up by long harrows, and ſet in heaps on the ſhore for putrefaction, and in length of time,

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for manure. This cleaning of ponds, muſt never be done in a ſpawning-pond, where it would be the deſtruction of thouſands of fiſh.

Autumn is the beſt ſeaſon for catching ſuch carp as are intended for the market. After the pond has been for five or ſix years in conſtant uſe, it is likewiſe time to let the water entirely off, and clear the pond of the mud, which often increaſes too much, and becomes a nuiſance. When the pond is dry, it may be ploughed before the froſt ſets in, and next ſpring oats or barley ſhould be ſown in it, after a new ploughing; and it will repay the trouble to the owner with a rich and plentiful crop. When the looſe ſuperfluous mud is carried off out of the pond, care ought to be taken not to take the ſoil below the original level of the pond.

Some people ſow a pond, which hath been laid dry for ſome months, with oats; and when they are growing, they fill the pond with water, and introduce carp for ſpawning, and think, by this contrivance, to procure food for the fiſh and ſomething to rub their bellies againſt. But this practice ſeems to be more noxious than beneficial; for the growing oats will putrefy, and communicate putridity to the water, which can by no means be ſalutary to the fiſh.

The epicures ſometimes feed carp, during the colder ſeaſon, in a cellar. The following method is the beſt that can be obſerved for that purpoſe. A carp is laid on a great quantity of wet moſs, ſpread on a piece of net, which then is gathered into a purſe, and the moſs ſo contrived, that the whole fiſh be entirely wrapt up in it: however, care muſt be taken to give the fiſh eaſe, and not to ſqueeze it, ſo that

it may have room to breathe in this confined attitude. The net with the fish and moss is then plunged into water and hung up to the cieling of the cellar. In the beginning, this operation must be very frequently repeated, at least every three or four hours; by length of time the fish will be more used to the new element, and will bear to be out of water for six or seven hours *. Its food is bread soaked in milk, which, in the beginning, must be administred to the fish in small quantities; in a short time the fish will bear more and grow fatter. I saw the experiment tried in a nobleman's-house, in the principality of Anhalt-Dessau; and during a fortnight, I visited myself, every day, the fish, together with the young nobleman, my friend, whom I accompanied to his seat from the university, during the Christmass-vacation. After the fish had been kept in the above manner during a fortnight, it was dressed and served up at dinner, when every one present found it excellent in its flavour. At my late uncle's, I had an opportunity of repeating the experiment on a carp

* It is known to every one that a carp will live a great while out of water; but perhaps it may not be so notorious, that the keeping him several hours in the common air, without any precautions, may be repeated from day to day, without any apparent inconvenience to the fish.

There is a fishmonger near Clare-market, who, in the winter, exposes for sale, a bushel at least of carp and tench, in the same dry vessel: but a small proportion of these can be sold in a day; and I have frequently been informed, that the fish continue in good health, notwithstanding their being thus exposed to the air six or seven hours for several successive days.

D. B.

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that had been brought 20 miles wrapt up in wet moſs; but after the fiſh had been kept three days in wet moſs, during which it was freſh and healthy, it was employed to regale a friend, whoſe unexpected arrival accelerated its fate, before the experiment was finiſhed.

John Reinhold Forſter.

XXXVIII. *An Account of the remarkable Cold observed at* Glasgow, *in the Month of* January, 1768; *in a Letter from Mr.* Alexander Wilson, *Professor of Astronomy at* Glasgow, *to the Rev. Mr:* Nevil Maskeline, *B. D. F. R. S. and Astronomer Royal.*

Reverend SIR,

College, Glasgow, May 29, 1771.

Read Nov. 7, 1771.

HAVING of late had some leisure time, I have made out from my minutes, a detail of the remarkable cold which prevailed here in the month of January, 1768; the intensity of which being so extraordinary for this climate, an account of it may perhaps be thought worthy of a place in the Philosophical Transactions.

Whilst in bed, on sunday morning, January 3, 1768, about 8 o'clock, it felt somehow unusually cold. A little while after, on reaching out for a decanter which I had placed near me the preceding night,

night, with ſome water in it, I was ſurprized to find the ſurface of the water frozen over, the like not having happened before in that place. Upon this, I deſired my ſon to try the cold by a thermometer, as I imagined it behooved to be very intenſe. The experiment was ſoon after made, by expoſing a thermometer at a high North window, and free from the walls of the houſe; in which ſituation it had not remained for a quarter of an hour, when we found the mercury had fallen ſo low as to 5 deg. of Fahrenheit's ſcale.

Although I had expected a great degree of cold, yet I was not quite prepared for ſo extraordinary a report as that which the thermometer now gave me. My doubts were, however, ſoon ſettled, by examining matters with more attention, and by finding the firſt thermometer verified by my ſtandard one, which was now hung out beſide it.

Being thus ſatisfied that there was no fallacy in this preliminary obſervation, it naturally occurred, that the cold, however intenſe it now was, might have been much more ſo at ſome earlier hour of the morning. But how to aſcertain this, and to recover the loſt obſervation, was the difficulty. In the eagerneſs of our diſappointed curioſity, we were diſpoſed to magnify this golden opportunity, which had now eſcaped us, and to reflect upon it with regret, when luckily a little invention helped us out. A notion ſuggeſted itſelf, that, if we went very warily to work, we might perhaps ſurprize thoſe imagined colds ſtill lurking under the ſurface of the ſnow, which at that time lay thick upon the ground.

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I need not mention upon what principles of the heating and cooling of bodies this expectation was founded, as they will readily occur of themſelves. The fact was, that I immediately repaired to the fields, and ſought out a low place, upon which the ſun had not then riſen; here I laid the thermometer in the ſnow, almoſt upon the very ſurface, when preſently the mercury ſunk from + 6 deg. to — 2 deg. which therefore I concluded to have been pretty nearly the coldeſt temperature of the air over night.

The next thing was, to make regular obſervations with the thermometer, ſo long as the cold promiſed to continue remarkable. The inſtrument was hung upon a pole near to the obſervatory, and to the windward of it, care having been alſo taken to keep it under a proper ſhade, ſo long as the ſun ſhone out.

Regiſter of the Thermometer, kept at the MFarlane obſervatory, of the college of Glaſgow, on ſunday January 3, and monday January 4, 1768.

Sunday	10 o'clock	+	5 deg.
morning	11		7
	12		9
afternoon	1		10
	2		11
	3		9½
	3½		6½
	4		3½
	4½		2
	5		1½
	5½		2½
	6		1½
	6½		0½
	7	—	1
	7½	—	0½

The temperature of the ſnow on ſunday morning, at about ten inches below the ſurface, was near to 30 deg.

	8	—	$0\frac{1}{2}$	
	$8\frac{1}{2}$	—	1	
	9	—	2	
	$9\frac{1}{2}$	—	1	
	10	—	2	
	$10\frac{1}{2}$	—	2	
	11	—	2	
	$11\frac{1}{2}$	—	1	Some appearance of clouds in the S. E.
	12	—	0	
	$12\frac{1}{2}$	—	$0\frac{1}{2}$	
Monday	1	—	1	
morning	2	—	0	
	$2\frac{1}{2}$	+	3	Clouds gathering, and some wind from E.
	3		6	
	$3\frac{1}{2}$		7	
	4		9	Quite overcast, wind E.
	$4\frac{1}{2}$		10	Ditto
	5		12	Ditto

It was observable, that after sun setting, the atmosphere had a tendency sometimes to turn a little foggy, and again quickly to clear up, balancing, as it were, betwixt these two different states. It is worthy of notice, that the minute variations of the thermometer, as set down in the above register, seemed to depend upon these different constitutions of the air; the mercury always rising in the thermometer a small matter, when the mistiness came on, and *vice versa*.

In the intervals of observations, we made some other experiments, which the present intensity of the frost suggested; particularly one relating to the evaporation of ice, which was tried in the following manner. I took a square reflecting metal belonging to my own two foot telescope, and exposed it on the ballustrade of the observatory, till it had acquired the temperature of the place, which was then at 0 deg. after it

 was

was thus cooled, I breathed on it repeatedly, till its polished surface was covered over with an incrustation of ice or frozen vapour, of a very palpable thickness. In this condition the speculum was replaced in its former situation, having its incrusted surface exposed to the still open air; when, in a little time, we found the frozen pellicle begining to disappear at the outer edge, all around, leaving the metal quite clear. Gradually more and more of the speculum was bared in a regular progression, from the circumference towards the centre; and at last, in about 50 minutes, the whole surface had parted with its ice. This experiment was repeated when the speculum was defended from the open air, by a large thin box, with a cloth over it. The event turned out the same as before, only it required longer time.

This progress of the evaporation from the outward parts towards the centre of the speculum, was likely owing to the original plate of ice being thickest towards the center, a circumstance which might arise from the manner of fixing it at first breathing on it. Or perhaps it may be imputed to some more curious cause, and may be some effect of the repulsive force belonging to the polished surface; but this point we did not sufficiently examine into, by a due repetition of experiments. I may just mention, that, partly with a view to this matter, we exposed as above, a set of bodies, having their surfaces of different degrees of polish, and as equally covered with frozen moisture as we could judge. The result of which experiments seemed to favour the idea of the ice being less attached to the more polished surface than to the coarser. This appeared particularly in the

case

case of a comparison made betwixt the speculum above-mentioned, and the brass end or cover of the same telescope; for the ice was found still to cleave to its surface a good while after the speculum was entirely cleared. These imperfect experiments are only mentioned by the bye, and may perhaps serve as hints to others, who may be disposed to prosecute this part of natural philosophy.

Some particular reasons have occurred, which will hinder me from transmitting to you the paper on the solar spots, till some time next winter, by which time I shall have finished every thing I have to say on that subject. Wishing to hear from you at your leisure, I ever am, with much respect,

Reverend Sir,

Your most obedient servant,

Alexander Wilson,

Professor of Astronomy at Glasgow.

Received November 15, 1770.

XXXIX. *Some Experiments on Putrefaction; by* F. L. F. Crell, *M. D. and Professor of Chemistry at* Brunswick.

Read Nov. 7, 1771.

THE celebrated lord Bacon [a] has, without doubt, shewn a very great sagacity, in pointing out to posterity, putrefaction, as a subject, worthy of making further inquiries into; and certainly, as there happen daily so many changes, not only in the inanimate, but also in the animate world, carried on by its means; the knowledge of every thing relating to it must clear up a great many points in natural philosophy, not thoroughly understood before. But these inquiries ought to be still of more consequence to mankind, as health depends greatly upon keeping in due bounds putrefaction, which the body naturally tends to. For these reasons, Sir John Pringle deserves, besides his other eminent merits, very great praises, on his having made many experiments on this subject; and medicine is indebted to him for considerable improvements resulting from them. He has besides opened the

[a] Nat. Hist. Cent. IV.

the way to many other gentlemen, among whom excell Dr. Gaber, and Dr. M'Bride, whose numerous experiments shew the ingenuity, and sagacity, they are possessed of: but the subject is not yet exhausted, nor will it be very easily. I have made some experiments relating to it; and should be very glad, if they threw a new light on some points of the greatest importance to medicine.

Dr. Gaber has proved, by his experiments, the presence of a volatile alcali produced by putrefaction; but as he did not discover by the same proceedings [*b*] any in its beginning or end, though there was a very putrid smell, he denies its existence in these states, and concludes, that this volatile alcali is not a necessary product of putrefaction [*c*]. This doctrine seemed to me not quite conformable to the phænomena: for, as all smell, as much as we know at least till now, depends on a saline matter, joined with a

[*b*] Acta Taurinens. Vol. I. p. 78. Cùm attegerint summum effervescentiae gradum, continuato ejusdem loci calore effervescentiae vim amiserunt. P. 79. Citius plerumque prodiit foetor, quam alkali, idemque tardius desiit. P. 82. Massam inde relinqui foetentissimam, sed emisso alkali ad effervescentiam ineptam.

[*c*] Id. p. 83, 15. Quum foeteret gravissime residuum destillationis, quamquam omni alkali orbatum, manifestum videtur, ab alkali foetorem exaltari quidem posse, & magis penetrantem effici, non autem ab eodem produci, quandoquidem superest eo sublato—16. Videtur is odor a volatilibus admodum particulis proficisci, sed quae ab alkali dissimiles sunt, plerumque citius gignantur, tardiusque dissipentur—alcalescentia adesse potest medico foetori conjuncta—vicissim maximus foetor absque alcali—Ex quibus differentia inter foetidas alcalinasque partes confirmari videtur.—P.84, 17. Videtur alcali non esse productum necessarium putrefactionis neque gradum alcalescentiae gradui putrefactionis respondere.

 phlogiston,

phlogiſton, and the ſaline matter producing the putrid ſtench, was not very likely an acid; I ſuppoſed it to be a volatile alkali, which, involved in phlogiſtic matter, might fly off, before the alkali was developed. I wanted to know by experiment, if I was right; for this purpoſe, I put, the 19th of June (the thermometer being 58° of Fahrenheit, and continuing between 58° and 62° all the time I obſerved), in a pretty large receiver, ſome beef cut in very ſmall pieces; I covered the bottom with it thinly, and poured upon it water, about two inches high. The 22d, the putrid ſmell was very ſenſible: but I let it ſtand till the 24th, when I poured off the fluid [*d*], adding again about the ſame quantity of water to the fleſh. I filtrated then the fluid through a piece of fine linen, and mixed with ſome of it the ſyrup of violets, which it did not alter; neither did it efferveſe with the ſpirit of vitriol, diluted to a ſharpneſs near that of the vegetable acid. I thought of keeping it in digeſtion for ſome days; but, for fear that ſome little ſolid particles might have paſſed through the linen, and by that means, in growing putrid, might give ſome alcali, and render the trial inaccurate, I diſtilled the fluid by a heat of about 160°, after which, I repeated the trial with the ſyrup of violets and the ſpirit of vitriol; but it produced no

[*d*] It requires ſome attention to find out the proper time when to pour off the liquor; if it is done too ſoon, it will give too little volatile alcali to be much ſenſible by experiments; for, though it ſmells ſtrongly, it is known how little matter is required to produce a ſtrong ſmell. If it is delayed too long, it ſhews already ſigns of an alcali. For that reaſon, I made many experiments in vain.

change.

change. I then put it, the 25th, into a retort, fitted to it a receiver, applied to the jointure a ring of paſte made of flower and water, covered it with a piece of wet bladder, and expoſed it in a *balneum arenæ* to a heat of 108° to 116°, till the 29th of June, when the whole fluid was diſtilled over. I perceived during this operation, that the liquor, from being quite tranſparent, grew turbid; the firſt diſtilled tranſparent fluid grew alſo turbid in the receiver, and at the bottom of the retort there was a ſmall ſettlement of a whitiſh earth. The liquor had a particular ſmell, but quite different from a putrid one, inclining to the volatile alcali; and ſhewed a ſlight but ſenſible degree of efferveſcence with the ſpirit of vitriol; and the ſyrup of violets was turned evidently green by it.

In the mean time, the fleſh with the water continued to emit a putrid ſtench; and the 28th of June I found the fluid colouring the ſyrup of violets greeniſh, and ſhewing a kind of efferveſcence with the acid. Both theſe qualities were increaſing every day, till the 8th of July, when, on account of a journey, I could not obſerve it any longer. I had left the mouth of the receiver open; and on my return the 1ſt of Auguſt, I found an exceeding putrid ſmell; I covered the veſſel; and the 2d, examined the fluid, but it did not efferveſce any more. I then filtrated the liquor; but the fleſh was ſo rotten, that a great many particles paſſed through the linen, and rendered it turbid. I put it into a retort, adapted a receiver, and luted it, as before-mentioned; the heat was alſo the ſame, between 108° and 116°. In this warmth it continued for about four days, when the fluid was diſtilled

diſtilled over. On opening the veſſels, the ſmell was again entirely changed, not near ſo diſagreable as before. In the receiver I obtained a fluid, which turned the ſyrup of violets green, efferveſced very ſmartly with the very ſame ſpirit of vitriol I had uſed before; gave the ſmell of a volatile alcali, on adding to this the fixed alcali; praecipitated the calces of metals diſſolved in acids, and ſhewed itſelf by all proofs a true volatile alcali. In the retort remained a yellowiſh matter, almoſt without any ſmell. I put to it ſome water; and after 24 hours, it gave the herbaceous ſmell, but ſhewed no ſigns of any alcali. I let it ſtand four days longer: the herbaceous ſmell continued; but there was no alcali to be diſcovered. I diſtilled it with a gentle fire: but neither then did there appear an alcali [e]; and by applying a ſtronger fire, I got nothing but a kind of empyreumatic oil.

I had poured, the 3d of Auguſt, ſome freſh water on the putrid matter; its putrid ſmell continued; the 7th I decanted the fluid, filtrated it, and made it undergo the ſame operation, with exactly the ſame effect as before; which I did again the 11th, with the very ſame effect. I did not repeat it oftener, as I had occaſion for this putrid fleſh to ſome other purpoſe.

Theſe experiments ſhew, I think, that the volatile alcali is preſent as long, at leaſt, as the putrid ſmell

[e] What this herbaceous ſmell did depend on, I did not enquire any farther, as not relating to medicine, ſince a living body never was found in ſuch a ſtate: but very likely it depends on ſome volatile alcali, which is perhaps in ſo very ſmall a quantity as not to be perceptible by experiments.

continues,

continues; and that this volatile alcali is the basis of it, because, as this was distilled over, the residuum, being still in intestine motion, got only the herbaceous smell. The reason, why the volatile alcali has been distinctly observed at a certain period of putrefaction, and not in the others, is, I believe, this; the volatile alcali has, it seems, a tendency, to disintangle itself, by intestine motion, of all such matter as it is involved with; but if it is not combined with such fixed matter as retains it till it has gone through all its evolutions, it is, being itself volatile, carried off by the still more volatile phlogistic matter with which it is commonly joined. For this reason, I suppose, the putrefying matter shews in its beginning no sign of a volatile alcali; because its smell depends only on those particles, which have been on the surface, without any strong cohesion with the substance. In the farther progress of putrefaction, the matter involving the alcali, or forming it, is intermixed, and in cohesion with the solid particles of the substance, and is by these means retained till the alcali is come to its purer state. Towards the end of putrefaction, the cohesion of the particles being almost entirely taken off, the volatile alcali is carried off before it can go through all its states.

If it is therefore true, that the volatile alcali is essential to, or at least always present in putrefaction, it seems to follow, that the alcalies never can be used in living bodies, as antiseptics [f], for laying

[f] It is very difficult, methinks, to account for the antiseptic power of the volatile alcali, and other salts, on dead animal sub-

aside their stimulating quality, which must prevent their use in most of the putrid diseases, they would increase the morbific matter, by being intimately mixed by circulation with phlogistic matter, which they find in abundance in such bodies. It has been objected to this, that the exhalation of stale urine, though shewing a great quantity of volatile alcali, is inoffensive to health [g]: and that some persons have taken the volatile alcali in very great quantity, without its bringing on a putrid disease [h]: but there

stances: I once thought, that as the ammoniac salt, nitre, &c. bring down the thermometer several degrees, perhaps all these salts acted by instantly absorbing the heat produced by the beginning intestine motion; and that, as a certain degree of warmth is necessary to putrefaction, in preventing this degree from coming on, it might hinder the whole operation. To see by experiment how far this might be true, I put into phials a certain quantity of water, with that proportionate quantity of alcalies, fixed and volatile, sal ammoniac, &c. which Sir John Pringle had found (Append. p. xvi. xvii.) to be antiseptic; and in one as much pure water as a standard. I stopped every one of them with a cork, in which I had made a hole for a thermometer of Fahrenheit. I exposed all these phials to the same heat; Sir John had used about 112; but I found, that both those with the salts and that without it marked the same degree of heat; and that therefore the absorption of heat can by no means be the reason of the putrefaction being stopped. May this phænomenon not depend upon the salts penetrating the body, and giving to the particles more *puncta contactus* (according to their greater or less affinity)? and may not these salts, in augmenting cohesion, hinder the fluids from separating themselves from one another, and, in consequence, prevent intestine motion? Is this not somewhat confirmed by the action of adstringents? and by the most powerful actions of metallic salts, as being of the greatest specific gravity?

[g] Sir J. Pringle, Append. p. vi.
[h] Id. ibid. p. xcii.

are

are however ſome examples[i], where it has been hurtful. It is urged further, that a perſon, being only for a ſhort time expoſed to really putrid exhalations, may be infected with putrid diſeaſes; and therefore that this effect of putrid exhalations does not depend on the volatile alcali, as it may be taken pure in very large doſes, without producing ſuch effects. To this I reply, by an analogous inſtance; a ſmall quantity of ferment will bring on fermentation in a large maſs of fermentable matter, and yet as much acid as could be obtained from the ferment, far from exciting an inteſtine motion in the fermentable matter, would rather check it; but can it, for all that, be denied, that the involved acid in the ferment is the chief cauſe of ſetting the whole maſs in fermentation? In the ſame way, the alcali combined with phlogiſtic matter may produce ſuch inteſtine motion as the pure alcali cannot; and very likely the firſt would not produce it, if the volatile alcali in it could be changed.

To bring this about, the moſt powerful means ſeem to be the uſe of acids; and the moſt celebrated phyſicians agree in the good effect they have obſerved from acids in putrid diſeaſes, and recommend them ſtrongly. Dr. M'Bride thinks otherwiſe, and his reaſons are theſe: *firſt* that if the acids came unchanged to the abſorbent veſſels, they would not admit of them [k]; *ſecondly*,

[i] Huxham on the ſore throat, p. 67, 68. Ejuſd. Eſſay on fevers, p. 118, edit. 5.

[k] Experiment. Eſſays, edit. ſec. p. 20. The auſtere acid (generated in the firſt paſſages of weakly perſons) is exactly in the ſame ſtate with a foreign acid, for the lacteals will admit none of it.

 if

if they did, they would be dangerous [*l*]; and *thirdly* that they are quite changed, before they leave the *primæ viæ* [*m*]. As for the *firſt*, I do not know what reaſons Dr. M'Bride founds his aſſertions upon, as acids never are given in ſo concentrick a ſtate, as by their aſtringency to make theſe veſſels ſhut up their orifice; and as metallic ſalts themſelves are abſorbed in their very compound ſtate (which ſeems clear with regard to the corroſive ſublimate, and other ſuch ſaline preparations), I do not ſee, why the ſimple acids could not be abſorbed. The *ſecond* reaſon ſeems to be founded upon ſome of Dr. M'Bride's experiments (p. 132, 133), *viz.* that putrid fleſh, ſweetened by diſtilled vinegar and ſpirit of vitriol, was firm; but on being boiled went quite to pieces, whereas that ſweetened by volatile alcali did not. But, I conceive, theſe experiments are not applicable to a living body: for the acid being there mixed with the fluids, cannot act in this way on the ſolids, till the fluids are (if I may uſe that

[*l*] Ibid. p. 134. the acids diſſolve the elementary earth, and thus deſtroy the texture of that ſubſtance, whoſe ſoundneſs they are ſuppoſed to reſtore.—P. 148. we are not to expect, that they are to pervade the minute branches of the vaſcular ſyſtem; when indeed it is evident, that they ought not to be allowed to paſs into the blood in their acid form; ſince it is plain, that, from their diſſolvent nature, the body muſt be deſtroyed, and its moſt ſolid parts melted down to a jelly, if naked acids were to be received into the general maſs of fluids.

[*m*] Ibid. p. 148. acids are neutralized during the alimentary fermentation; and therefore they cannot act as acids, by ſaturating any thing of the alcaline kind that they meet with in their courſe of circulation.

expreſſion)

expreſſion) ſupra-ſaturated with the acid [n], which in putrid diſeaſes cannot be the caſe. And farther, a heat of 212° of Fahrenheit never can increaſe the action of the acids in living bodies, as it did in the experiments; for, though Dr. M'Bride denies this conſequence, and will prove the contrary, as the fleſh with the alcali did not diſſolve; yet this circumſtance proves nothing more, than that the volatile alcali has not ſuch power of diſſolving the gluten of animal fibres, as acids have; for, if the effect depended only on the action of the acids by themſelves, the fleſh would rather have been diſſolved when immerſed in them, than when boiled in water.—The Doctor beſides ſeems not quite conſiſtent on this head; for, p. 151, he ſays, "Adſtringents can only "be of importance in thoſe caſes, where, from "extreme relaxation and reſolution of the ſolids, the "diſſolved fluids are ſuffered to tranſude, and either "form ſpots of different hues, or run off by actual "hæmorrhage; here, indeed, the acid of vitriol, as "an aſtringent, not as an acid, is found of great uſe "in gaining time." As the acid could not exert its aſtringent power on the veſſels, without coming to the *ſecundæ viæ* (p. 153.) he ſeems not afraid, in this caſe, of its melting down the moſt ſolid parts to a jelly.

In proof of his *third reaſon*, he alledges ſome experiments; *viz.* the third, p. 40, where a mixture of *fleſh*, bread, lemon juice, and ſaliva, did not efferveſce, after fermentation with an alcali; and the 5th,

[n] This has, it ſeems, happened in ſome rare caſes quoted by Dr. M'Bride, and Dr. Haller, p. 148.

p. 42,

p. 42, where a mixture of bread, water, ſaliva, and ſpirit of vitriol efferveſced ſmartly, before the inteſtine motion; but not at all after it. I could object againſt theſe experiments, and eſpecially the 5th, that perhaps the proportion of the ſaliva to the acid was too great, and that a perſon in a putrid diſeaſe ought to take more acids than could be neutralized by the inquiline liquors. However, I will not inſiſt on this; and ſuppoſe theſe experiments to be quite applicable to the caſe: but if theſe mixtures do not efferveſce any more, does it follow, "that "they are neutralized, and therefore act as acids, by "ſaturating any thing of the alcalinous kind, that "they meet with, in their courſe of circulation?" There are ſome ſaline bodies, which do not efferveſce when mixed together; which will, however, change one another's nature. Thus *f. e.* brimſtone, mixed with a ſtrong fixed alcali, does not efferveſce [o], but changes, on being diſſolved, the nature of the alcali. A ſolution of ſoap does not efferveſe on the addition of an acid, but joins with the acid, and neutralizes it. Theſe inſtances made me ſuſpect the concluſion drawn by Dr. M'Bride from his experiments; and to clear up theſe doubts, in this particular caſe, I referred to experiments. For this purpoſe, I mixed, the 4th of Auguſt, the thermometer being at 64°, three ounces of ſaliva, a dram of the liquor of

[o] This applies alſo to the ſolution of brimſtone in limewater, out of which the lime particles have been precipitated, by the intoduction of fixed air.

putrid

putrid flesh, and a very small quantity of bread: and added as much of the diluted spirit of vitriol, as to make it sour, and effervesce definitely with the alcali. There was not any sign of intestine motion till the 7th of August, when from time to time some air bubbles, and also some solid particles, rose to the top; and this continued till the 8th. Not perceiving any farther motion, I poured off the clear liquor, which did not effervesce any more with the alcali. I mixed, the 9th, six drams of the putrid liquamen, with about the double of this liquor, and put in besides four solid pieces of flesh, which had lain three days in the liquamen: these pieces were of a prodigious stench, and so rotten, that with the least force they were torn to pieces. There appeared no signs of intestine motion: the 10th, the putrid smell was very much abated: the 11th, it was changed, and there remained only a smell much like that of sound flesh: the pieces were without any smell, and had acquired again some degree of firmness. In this condition they remained for a week, and I did not observe them any longer.

This experiment proves, I believe, that acids, though changed in the alimentary canal so far, as not to effervesce with alcalies, may notwithstanding check putrefaction; and that, therefore, their use is of great consequence, and ought not to be omitted in putrid diseases. Though Dr. M'Bride believes that these diseases may be cured with fermentable substances only; I must own that I do not agree with him, and am not quite convinced of his opi-

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nion, that putrefaction depends only on the loss of fixed air. I rather believe this an effect than the cause of putrefaction; but I shall refer this subject to another occasion.

END OF PART I.

Date of issue.	Date of issue.	Date of issue.